OFFICIAL PUBLICATION

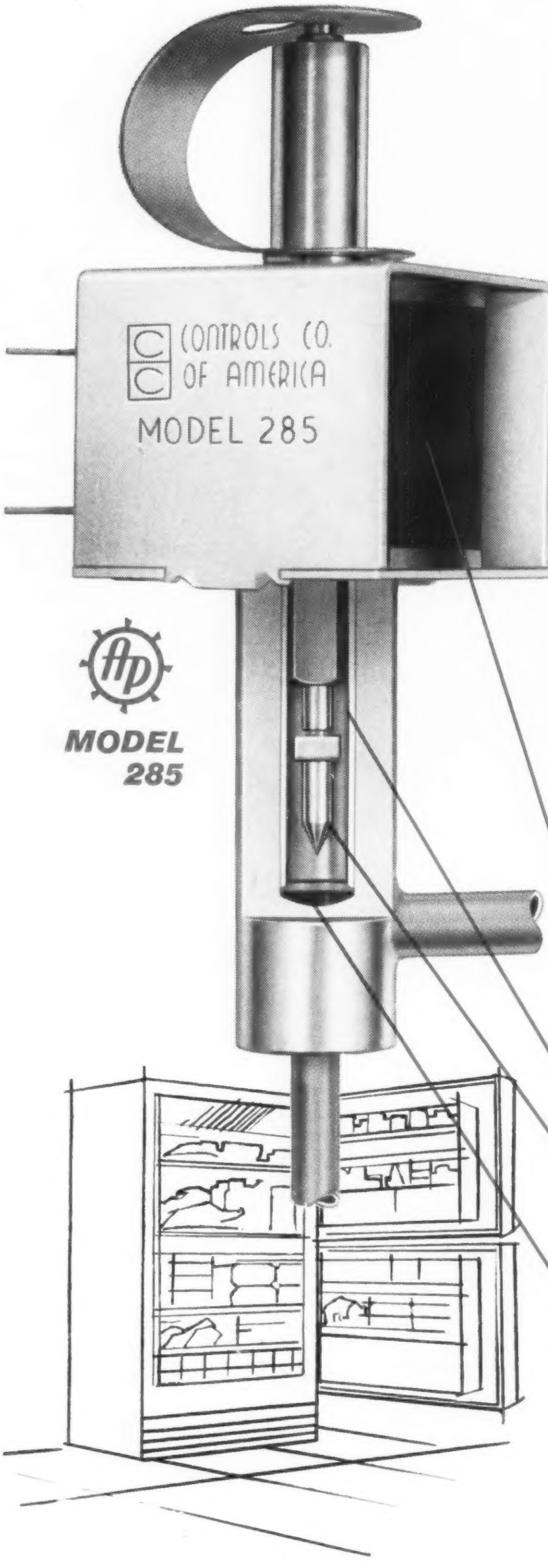
ASHRAE JOURNAL

Heating ✦ Refrigerating ✦ Air Conditioning ✦ Ventilating

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS

DECEMBER 1960

Open and shut case for the only valve that offers "nonstick" dependability for refrigerators utilizing hot gas defrosting



This new Model 285 hot gas defrost valve always opens and closes on schedule, making automatic defrosting of domestic refrigerators and home freezers absolutely foolproof. Everything possible has been done by Controls Company's engineers (see cutaway) to prevent "hanging-up" and the food spoilage that results from such valve defection. That's why if you're considering hot gas defrosting, your opening move is to investigate the new A-P Model 285. Write today for full facts.

Here's how A-P engineers solved a sticky problem

SOLENOID lifts needle . . . gravity plus pressure drop closes it. Solenoid coil is encapsulated with a layer of EPOXY resin — moisture resistant for long life. Coils available with open yoke (shown) or total metal enclosure.

PLUNGER TUBE is stainless steel with "mirror-smooth" internal surface finish. Highest corrosion resistance.

STAINLESS STEEL NEEDLE slides smoothly without sticking. Head of needle is radiused to give one-point contact in open position. Edges of plunger are rounded for minimum friction and long life.

VALVE INTERIOR is polished to within 20 rms for minimum coefficient of friction. Seat as well as needle is of stainless steel adding to no-stick, long-life operation.

MISCELLANEOUS SPECIFICATIONS: 3/32" orifice. 225 lb. lift. 200 cc/minute max. leak at 200 lb. dry air. Coils for 115- or 230-volt, 60-cycle service.

Creative controls for industry

CONTROLS COMPANY OF AMERICA

HEATING AND AIR CONDITIONING DIVISION

2456 N. 32nd Street, Milwaukee 10, Wisconsin • Cooksville, Ontario • Zug, Switzerland

HAC-18-60

DECEMBER 1960

VOL. 2 **NO. 12**

ASHRAE JOURNAL

OFFICIAL PUBLICATION

Formerly Refrigerating Engineering including Air Conditioning, and incorporating the ASHAE Journal.

FEATURE

NEWS

DEPARTMENTS

Member
Audit Bureau of Circulations

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Hughes Printing Company, East Stroudsburg, Pa.

Comment

ALONE ON A WIDE, WIDE SEA?

During the interval in which we have been responsible for the comments appearing in this space, there have been a number of pleasantly appreciative observations upon them by our member-readers. All welcome and mostly encouraging. Indeed, any expressions of protest have been literally negligible.

But just the other day, a member cornered us with "See here, I read your Comments every month, how does it happen that you almost always hit upon something that I have been thinking about; that I hold as a personal view and do not discuss with anyone, because I considered it contrary to what "they" are saying and urging. You make me feel that others care too; that I have company".

Frankly, we treasure that.

HOW EDITORIALLY WE?

For one thing, we relish the designation for this page as comments rather than as editorials. To observe is one thing; to pontificate or to opinionize is quite another.

Instinctively distrusting all absolutes, we substitute uncertainty for certainty in the hope of better meeting the ever-changing facets of a non-static world.

THAT SILENT MAJORITY

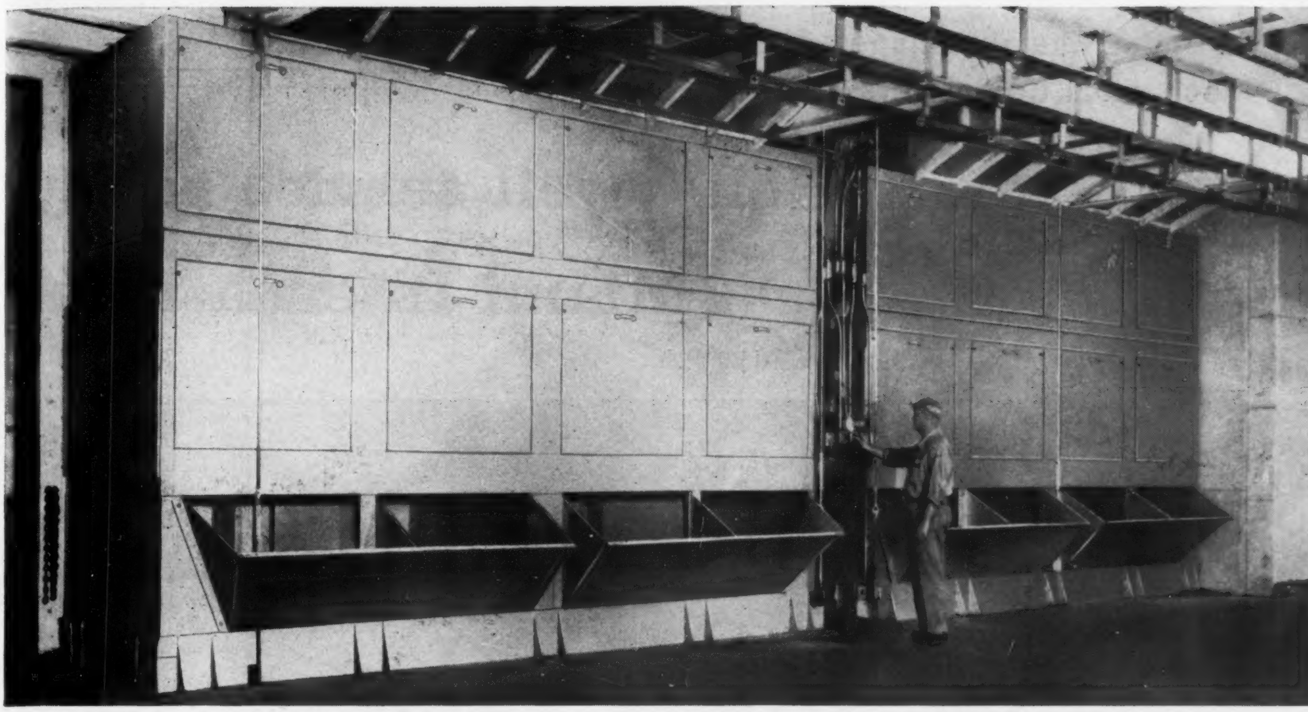
There are times when an Editor wants much indeed to hear from his largely unseen audience. In a Society, where he implements the injunctions of policy-making groups, he can but wonder sometimes if those served are as receptive to some policies as are those who set them.

Our By-laws state that the ASHRAE publications ". . . shall tend toward the professional education of the individual engineer; . . . be free from commercial bias; and tend to advance . . . the sciences relating to the arts of heating, refrigeration and air conditioning and ventilation . . .".

But how many of our 19,000 are so minded? How many belong to ASHRAE because it is a professional engineering society? How many because it does provide incidental social, commercial and advancement benefits of no mean—even overwhelming—proportions? What does each faction expect of the Society JOURNAL, of TRANSACTIONS and of BULLETINS?

Lest you think it easy for Officers, Committees, Editors, those who make surveys, those who probe and question and those who analyze bits of pertinent evidence to decide; we assure you that it is not.

Edward R Searles
Editor



Quinton Holland, Goldring chief engineer at control panel. CONTRACTOR: Jennings Refrigeration, Inc., Los Angeles.

KRACK BUILDS ONE OF

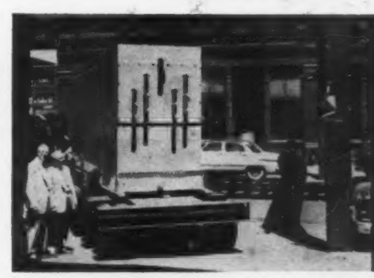
world's largest unit coolers!

SHIPS 6 WEEKS AFTER ORDER!

Custom-made unit has 110,000 CFM CAPACITY!

When the Goldring Packing Co., fast growing Los Angeles meat processing concern, built a new lamb chilling room they were faced with a refrigeration problem—to secure equipment with enough cooling capacity to hold a 50 x 120 ft. room at a constant 34°F. Ceiling mounted units were out, because of lack of clearance between the conveyor system and ceiling.

A large custom floor unit was the answer and through Pacific Metals Co., western KRACK distributors, the order was placed with Refrigeration Appliances. The completed unit measures 37′ x 12′ x 5′ and was shipped just six weeks after the order was received. The unit is built in two sections, each delivering 55,000 cfm. Automatic defrost is alternated every 24 hours.



Unit required two trucks for shipping. Here one-half of unit leaves Refrigeration Appliances plant at Chicago.

Opening in wall of new addition at Goldring Packing Co., Los Angeles permits entry of each half of the huge Krack refrigeration units.

Whatever your refrigeration problems are, you can depend on KRACK—for units that deliver SAFETY-MARGIN RATING—for QUICK DELIVERY on standard and custom units.

KRACK ENGINEERED REFRIGERATION APPLIANCES, INC.

Manufacturers of Freon or Ammonia, Recirculated, Flooded or Direct Expansion Heat Transfer Equipment

MAIL COUPON FOR INSTALLATION STORY & "BL" BULLETIN

REFRIGERATION APPLIANCES, INC.
917 W. Lake St., Chicago 7, Ill.

Name__________

Firm__________

Street__________

City__________ Zone_____ State__________

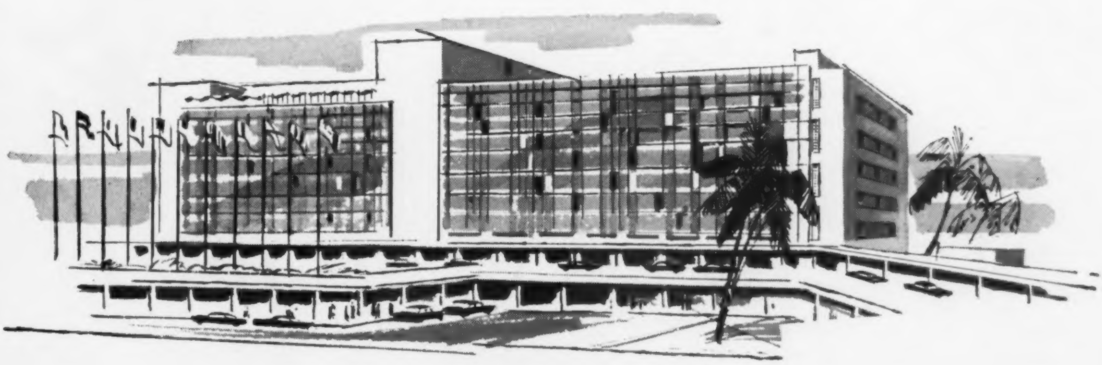
0299

Mr. Ed Smith, Miami Manager, The Poole & Kent Company, Mechanical Contractors, says:

"Honeywell service really Miami International

Mr. Smith on the airport observation deck overlooking the Miami International Airport Hotel. Honeywell temperature control in the hotel keeps travelers as comfortable as possible.

paid off for us on the Airport Hotel job"



Architect: Steward-Skinner Associates
Consulting Engineer: Mitchell-Gordon Associates
General Contractor: Fred Howland, Inc.
Mechanical Contractor: The Poole & Kent Company

Engineers from Honeywell's Miami office were always available and eager to help

"When we installed the Honeywell temperature control system at the Miami International Airport Hotel," says Smith, "Honeywell men were ready to handle any problem encountered. But Honeywell engineers had planned the system so well, we were easily able to maintain job progress."

According to Smith, "This is very important to our operation. Accurate shop drawings . . . the right equipment . . . there can't be a slip-up, or unprofitable delays will be encountered. This isn't likely to happen with Honeywell men on the job. Honeywell supervises a job from start to finish; and the equipment is the best available."

You get more to work with when you work with Honeywell. Easily installed controls, accurate specifications, prompt delivery and excellent supervision are the advantages enjoyed by every contractor with Honeywell on his team.

Call your local Honeywell office for details. There are 112 conveniently located across the nation. Or write Honeywell, Dept. AH-12-116, Minneapolis 8, Minnesota. In Canada, contact Honeywell Controls, Limited, Toronto 17, Ontario.

The Honeywell temperature control system installed in the hotel includes 270 individual room thermostats.

Honeywell
First in Control
SINCE 1885

75th YEAR PIONEERING THE FUTURE

Sales and service offices in all principal cities of the world. Manufacturing in the United States, United Kingdom, Canada, Netherlands, Germany, France and Japan.

Now that you Mention It—

SHADED SURFACES

To the Editor:

We were encouraged greatly by the article on the proposed procedure to estimate residential cooling loads reported in your October issue (page 43).

One item concerns us—the fact that no credit is given for shade on building surfaces. We note that the load calculated by the proposed method for the I-B-R Research Home is 52% in excess of the measured maximum load as listed in Table III. When factors for shaded glass are used, the total calculated load is still 28% greater than the measured maximum. The only explanation given for this discrepancy is the fact that the building is well shaded. In some locations, permanent shade is practically assured and a 28% penalty in equipment size seems too much to pay for simplification of load calculations.

Perhaps a simple table of correction factors for wall and roof surfaces, depending upon percent of shade, would be a worthwhile improvement.

L. BERT NYE, JR.
Superintendent

Technical Bureau—Utilization
Washington Gas Light Company

WHO'S WHO IN ASHRAE

Insofar as possible, these listings will each appear twice a year

ASHRAE OFFICERS, DIRECTORS, COMMITTEES, STAFF
See page 88, this issue

REGION AND CHAPTER OFFICERS
See page 82, November JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
See page 67, September JOURNAL

STANDARDS PROJECTS
See page 63, July JOURNAL

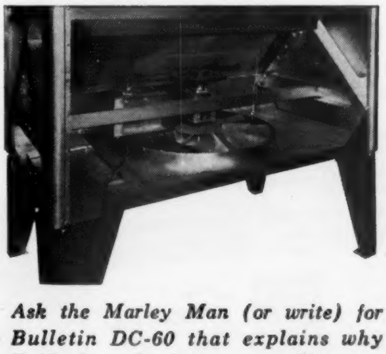
INTER SOCIETY COMMITTEES
See page 84, November JOURNAL

compatibility

stands out in

Marley Series B DriCooler®

AIR COOLED CONDENSERS



Ask the Marley Man (or write) for Bulletin DC-60 that explains why DriCoolers also have outstanding . . .

cap ability
dur ability
adapt ability
control ability

The ability to fit inconspicuously into the planning of new structures or into the surroundings of established buildings is an important characteristic of Series B DriCoolers. In designing these new, high-efficiency condensers, Marley engineers gave architectural compatibility equal precedence with durability and performance capability.

The trim, corrugated aluminum casing conceals fan, motor and coils—completely. The rigid, truss-type structural frame of these low height units is out of view. Diagonally mounted coils minimize over-all dimensions. Inconspicuous, unobtrusive, quiet—these attributes are characteristic of all Series B DriCoolers.

Series B DriCoolers are of vertical, blow-through design that is most adaptable to any desired location. Performance is never affected by wind direction or velocity, and recirculation of heated air is precluded by the air intake and discharge being at different and well-separated elevations.

U. S. and Foreign Patents Pending

THE MARLEY COMPANY MARLEY KANSAS CITY 14, MISSOURI

How can you measure the quality of refrigerants?

A measure of refrigerant quality is how well it performs during the life of the equipment. When performance and life are considered, the field is narrowed to but one choice—Du Pont "Freon".

In actual performance "Freon", the original fluorocarbon refrigerant, has established an outstanding record through its use in millions of air conditioning and refrigeration systems—a proven record of quality performance that has never been equalled.

In actual time "Freon" has been proven by 30 years of increasing use in all types of air conditioning and refrigeration equipment. All the accumulated know-how, experience, research and production facilities behind "Freon" add up to a record in which "Freon" refrigerants have withstood the test of time—one which no other refrigerant can equal.

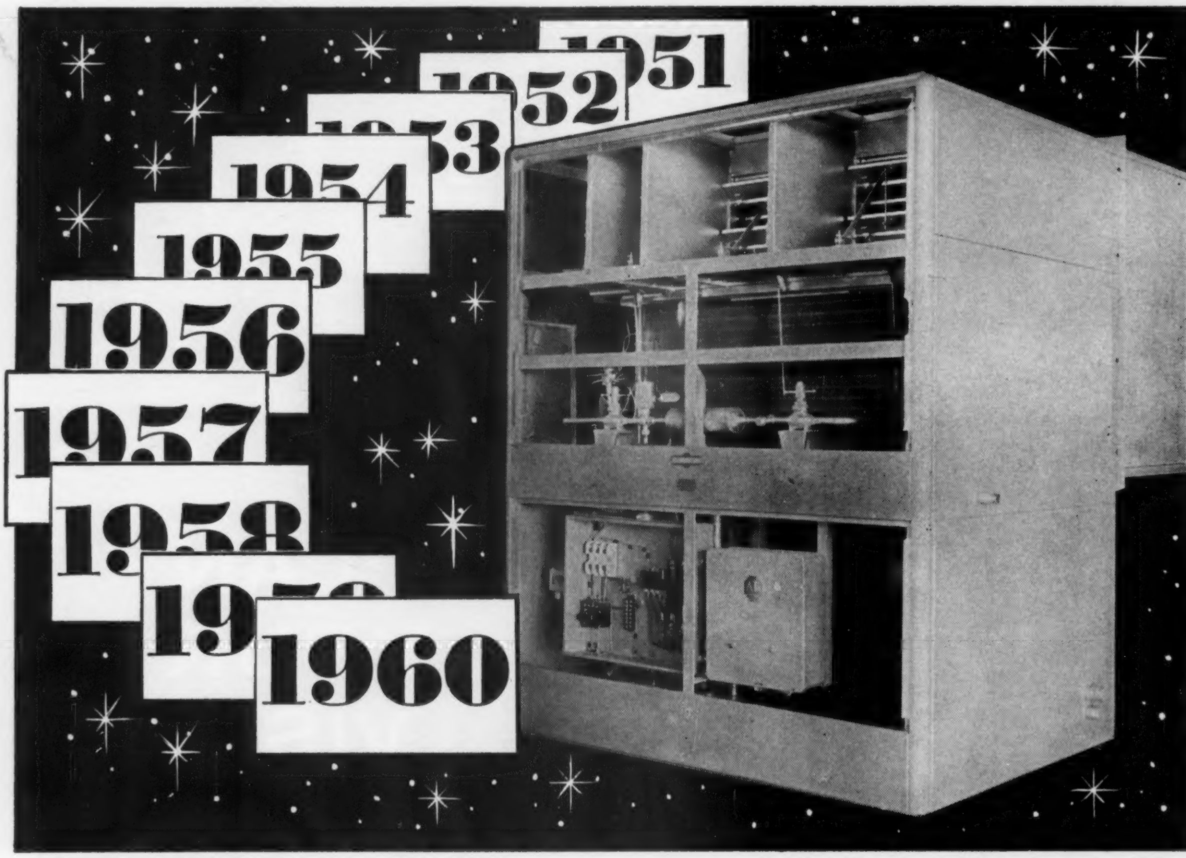
In addition, a continuing program of research and technical and marketing assistance is working to help improve today's products and to expand the future market for these products.

Any way you measure, it pays to use Du Pont "Freon". Specify it as the refrigerant in your equipment. It will never let you or your equipment down.

FREON®
premium quality
REFRIGERANTS

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



a decade of proven performance in self-contained multi-zone units

Yes, for ten years, GOVERNAIR has led the way in the engineering and development of self-contained multi-zone air conditioning units.

Both the Evaporative Condenser Package (type SCMZ) and the Water Cooled Condenser Package (type STMZ) are far beyond the pioneering stage, and have been tested and proven in actual use throughout the world, under widely-varied conditions.

Available in 8 through 100 tons, every unit is "Satisfabricated" to fit individual job zone and capacity requirements . . . assembled from the finest materials and components, then thoroughly factory-tested before delivery. For complete information, please write . .

Find it in the yellow pages GOVERNAIR

GOVERNAIR

4840 NORTH SEWELL • OKLAHOMA CITY, OKLA.

Late news highlights

Power conference

There will be special sessions at the forthcoming 23rd Annual American Power Conference in Chicago, March 21-23, sponsored by six national Engineering Societies, of which our ASHRAE is one. The Conference will concentrate upon central station power plants and recent developments in the field of nuclear power generation. Illinois Institute of Technology, nine cooperating universities, five regional universities and a total of nine cooperating societies are involved.

House heating

Now available in a revised edition "Electric House Heating" (Bulletin 142-1) has been re-issued by the Rural Electrification Administration, as of September 1960. Included are reviews of methods of heat transfer, of various types of electrical heating equipment, heating materials and construction requirements and of estimating and computing heating procedures. This 20-page publication is available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

Single Western Show

Foregoing its 1962 Show, the Western Air Conditioning Industries Association yields to the national Air Conditioning and Refrigeration Institute Show for that year. ARI will have the Los Angeles Great Western Exhibit Center, February 12-15, 1962. Past president, Arthur J. Hess of ASHRAE, currently vice-president of WAC, will be in charge of all technical sessions. WAC members will be hosts.

Tomorrow's research

The Engineering Research Committee of Engineers Joint Council, under the chairmanship of Dr. J. Herbert Hollman of the General Engineering Laboratories, of the General Electric Company, has undertaken a most ambitious program of studies, ranging from the provision of food for an expanding world, to the space-age transportation. The Committee has divided its work as between a dwindling supply of minerals and water, inadequate urban transportation, complexity of air transportation, management of defense engineering systems and the needs of under-developed countries.

Aircraft cooling

Most practicable systems for cooling the cabin and equipment of supersonic aircraft at high Mach numbers and high altitudes have been determined in recent Air Force research. Thus, Cooling Methods And Equipment For Supersonic Aircraft, by G. R. Werth, as published by the Douglas Aircraft Company for the Wright Air Development Div, is available from the U. S. Department of Commerce, Washington 25, D. C., at $3.00.

Short course

Supplementing the I-B-R Hydronic Heating School, the 13th Short Course offered by the University of Illinois in cooperation with the Institute of Boiler and Radiator Manufacturers, will be held at Urbana, January 30-February 2. Designed to assist heating contractors to achieve their managerial and technical objectives, this $40 lecture-classroom indoctrination will be paced to the owner-manager level.

International conference

Organized by the Institution of Heating and Ventilating Engineers in cooperation with the Association of Heating, Ventilating and Domestic Engineering Employers, and the Heating and Ventilating Research Association (all of Great Britain), there will be an International Conference on Heating, Ventilating and Air-Conditioning, and an associated International Exhibition in London, September 27-October 4th. This Conference will cover three main themes: Administrative advances likely in the next ten years; technical advances likely in the same interval; and, integrated design of architectural and engineering services for economy of building construction. Those wishing to submit papers or to make preliminary plans to attend may obtain descriptive leaflets from the Secretary, The Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London S.W. 1, England.

More Apprentices

Following closely upon the graduation of 30 apprentices (ASHRAE, Oct. 1960, p. 19) 250 journeymen have enrolled in the certification training program of the refrigeration and air-conditioning industry of Southern California. This project, sponsored by the Certified Refrigeration and Air-Conditioning Foundation, presently has 37 of the journeymen taking instruction for initial certification.

Steel for cryogenics Newly developed, a high nickel steel for the storage and transportation of liquefied gases, at temperatures as low as −320 F, recently underwent a most rigorous demonstration test to destruction, at the Fairless Hills (Pa.) Works of the United States Steel Corp. The alloy contains 9% nickel.

Glacial ice Shipment of rare specimens from the Canadian Arctic has brought safe arrival of fossil ice to Dartmouth's cold weather laboratory in Hanover, N. H. Cores, supposedly between 1,000 and 5,000 years old, came from within 300 miles of the North Pole. Temperatures were maintained between zero and 15 F to avoid changes in crystal structure. A similar study last year with fossil ice failed because of inadequate transportation facilities.

Central air conditioning Featuring high velocity air, aspirating registers and small, flexible insulating ducting, with the ability to handle small quantities of air at 40 F, a currently announced Jet-Cool system is cited as suitable for installation in existing homes, easily and speedily, without the necessity of major structure overhaul. Air velocity is 2,000 fpm.

NAS reports Within an elaborate and comprehensive 150 page booklet the Div of Engineering and Industrial Research of the National Academy of Sciences, National Research Council, has reported upon its 1959-1960 activities. Just issued, the report may be obtained from NAS, 2101 Constitution Avenue, N.W., Washington 25, D. C.

ECPD in Canada At the 28th Annual Meeting in Montreal of the Engineers' Council for Professional Development, early in October, more than 200 registrants heard talks by President W. L. Everitt of ECPD, who is also Dean of the University of Illinois, and by Colonel L. F. Grant, Past-President of ECPD and of the Engineering Institute of Canada. The group had as its host the Engineering Institute of Canada.

1959 Exports Elaborately compiled in connection with a forthcoming April 1961 issue of the American Exporter, a 22 x 15 in. chart provides a comprehensive analysis of 1959 exports of U. S. refrigeration and air conditioning products grouped as to items and indicating quantities and values. This compilation further shows dollar values by items of exports to individual countries and territories. Single copies available upon request from the American Exporter, 386 Fourth Avenue, New York 16, N. Y.

National Associations Within newly issued Directory of National Associations of Businessmen, 1960, are listed more than 2,000 associations together with full information regarding members, size of staff, identity of chief executive, year organized and other pertinent facts. A key word index permits ready reference to fields of service. Available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. – 50 cents a copy.

By World Refrigeration To be held in London, England, April 11-14, 1961, the Second International Refrigeration and Air Conditioning Exhibition will be sponsored by World Refrigeration (a publication). Accompanying will be a technical program. The provisional list of papers includes coverages of insulation materials, air conditioning for industry, thermoelectric cooling, aeronautical cooling, finishes and chemical aspects of refrigeration.

Space kitchen As an initial assignment in space engineering and research, under a contract to design and build a space kitchen, the Whirlpool Corporation will develop a unit to provide for all foods and beverages for three pilots on a 14-day mission. Space allowance is 10 ft long and 7½ ft diam to include miniaturized, thermoelectrically operated a refrigerator and a freezer, an oven and a 2½ gal capacity water system with its own heater. Operation must be under weightless conditions.

Automotive air conditioning Featured on the program of the 7th Annual National Forum on Auto Air Conditioning, Dallas, Texas, November 17, 18, were talks on engine and assembly cooling problems, upon passenger compartment noise and vibration considerations, upon drive components and compressors, upon developments in thermoelectric design and upon electrical and control systems. Sponsored jointly by the Texas Section of the Society of Automotive Engineers and the Automotive Air Conditioning Manufacturers Association the meeting included talks by ASHRAE members E. R. Boynton of Tecumseh Products Co., T. J. Ammel of York Corp., Del C. Albright of Controls Co. of America, D. G. Harter (AM) of York Corp., Anwar A. Atalla of Torrington Mfg. Co. (AM).

Important Information Available!

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BUSINESS REPLY CARD

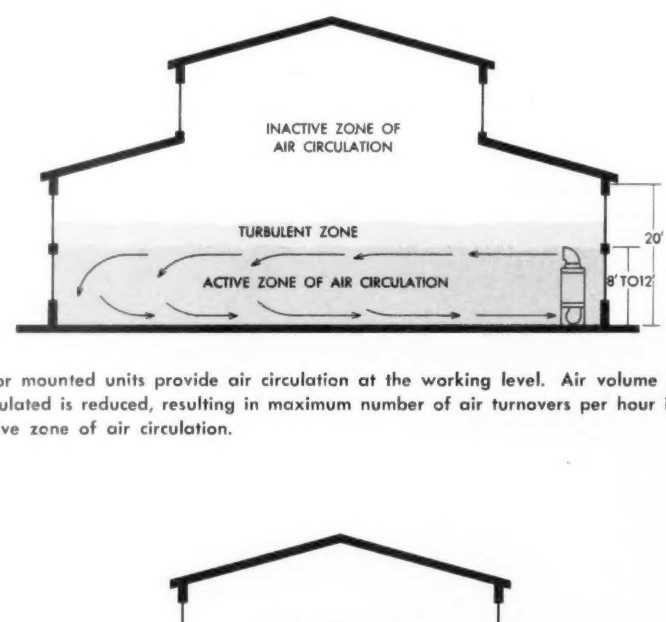
FIRST CLASS PERMIT NO. 53 MARSHALLTOWN, IOWA

Postage Will Be Paid by Addressee

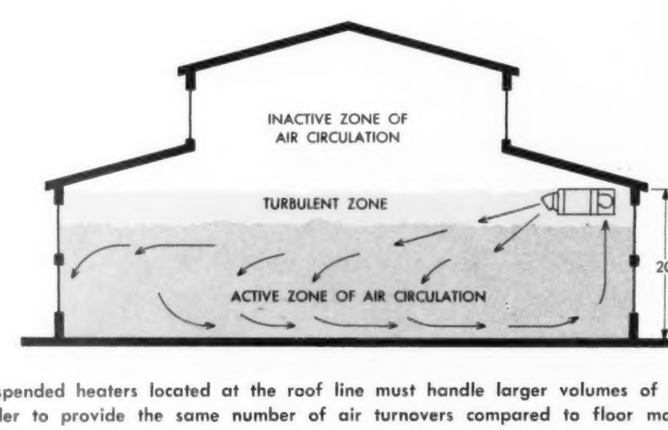
LENNOX INDUSTRIES INC.
DEPT. I-A123
MARSHALLTOWN, IOWA

get the most heating

Most industrial buildings are hard to heat and have high heat losses. Usually the heating system simply dumps enough heat into the building to keep the work level near the proper temperature. This wastes heat, causes drafts, creates "hot spots" and causes high ceiling temperatures. Lennox industrial heaters overcome such faults. The large capacity blowers and low internal resistance of the heaters make it possible to discharge large volumes of high velocity air above the heads of the workers. This eliminates hot spots and levels temperatures in all parts of the building. By locating the Lennox heaters on the floor you get more air changes per hour because only the air in the active zone (work level) is circulated. Because Lennox units heat only the work level, a minimum floor to ceiling temperature gradient can be maintained. Keeping the ceiling temperature at a minimum and circulating only the air in the work area with Lennox heaters considerably reduces the cost of heating industrial buildings.



Floor mounted units provide air circulation at the working level. Air volume to be circulated is reduced, resulting in maximum number of air turnovers per hour in the active zone of air circulation.

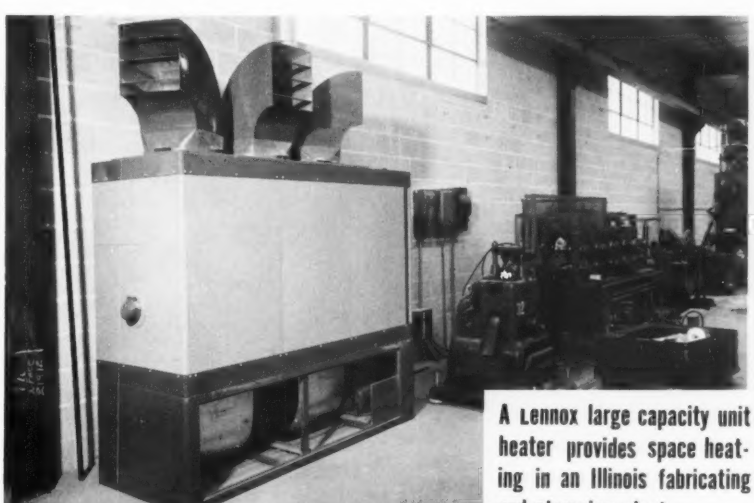


Suspended heaters located at the roof line must handle larger volumes of air in order to provide the same number of air turnovers compared to floor mounted equipment.

with the least expense with LENNOX space heaters

A Nebraska manufacturing company provides space heating and ventilation with Lennox large capacity unit heaters suspended from the ceiling. NOTE the old junked unit heaters in the foreground.

Lennox was chosen as replacement equipment for three reasons. The old unit heaters supplied enough spot heating for the previous use of the building, but would not provide sufficient heat when the building usage was changed. Now Lennox heaters provide uniform wall to wall coverage with no "hot spots". These units are equipped with both make-up air dampers and dual fuel burners. The air exhausted from the building is replaced by the heater rather than by infiltration of cold air. Considerable fuel cost reduction is realized with the dual fuel burners on the Lennox heaters. The plant is now on a money saving, interruptible gas supply rate not possible with the old heaters.



A Lennox large capacity unit heater provides space heating in an Illinois fabricating and stamping plant.

Lennox units were chosen for this job primarily for their large air handling capacity and their good service record in previous installations. The heaters are located along the outside wall and provide uniform temperature control over the entire building width. These units are oil fired with stack controls.

- direct-fired vs "wet" industrial heating
- heating and air conditioning
- make-up air and ventilation
- process work

* space heating

LENNOX

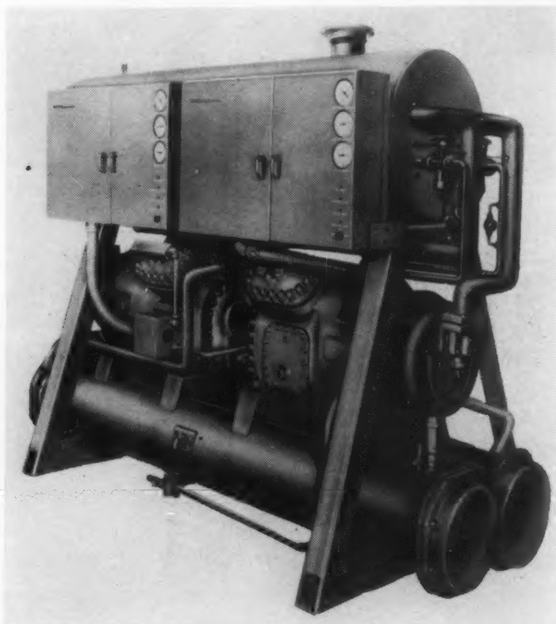
Commercial Equipment


SPORLAN
Famous Firsts...

PARTS and PRODUCTS

WATER CHILLER LINE

For industrial and commercial air conditioning installations, the PKB line of water chillers includes eight sizes of units in ratings from 20 to 100 ton. Compressor motors on the chillers are protected by a Guardistor overtemperature control circuit that provides positive motor protection against overheating from excessively high or low voltage, single phasing or loss of refrigerant from the compressor. In addition, quick trip overload heaters are included for positive six-sec kick-out on any overload condition.



Larger units, rated at 60, 80 and 100 ton, have twin compressors that provide step starting, demand charge savings during mild seasons and protection against complete loss of service in event of failure of one system. Each unit is compact and equipped with a wired control center that includes starters and safety operating controls. For process cooling and special commercial installations, 40 F leaving water temperature designs are available.
Westinghouse Electric Corporation, Air Conditioning Div, Staunton, Va.

HEAT PUMP LINES

For remote condensing unit installation, air-source heat pumps feature sight-glass moisture indicator, insulated drain pans, dual outdoor coils, heavy-duty compressors, filter-dryers in both liquid lines and crankcase heaters. Both indoor and outdoor models are constructed of heavy zinc-coated steel.

Fan-coil sections can be installed for six different air-flow arrangements in the field. Squirrel-cage fins provide high static and quiet operation. Compressor, changeover valve, receiver and other parts are separated by a bulkhead from the fan-coil section of the outdoor unit, allowing the equipment to be serviced without affecting air flow across the outdoor coils. These Auto-Temp units are manufactured up to 30 ton in both air-to-air and water-to-air models.

Produced in three, four and five-hp sizes, the new closet model water-to-air heat pump meters refrigerant to the chiller-condenser on the heating cycle, providing efficient heat transfer and positive oil return to the compressor.

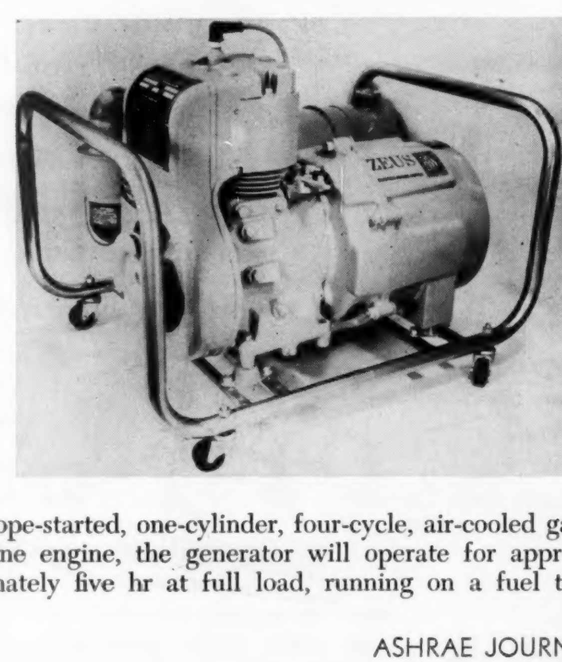
WAR Series water-to-air units are being produced in three, four and five-hp sizes, providing 3¾ to 6-ton capacity. These heat pumps are quite flexible, in that they can be used for package, remote condensing unit applications and the fan-coil section can be arranged for six different blower discharges.

Completely packaged and pre-wired eight and ten-ton water-to-air heat pumps feature a chiller-condenser incorporating a highly efficient jet for metering refrigerant. Pressure drop across the jet nozzle is used to provide a secondary spray of liquid refrigerant over the water coils. Oversized coils, sight glass, moisture indicator, oil separator and permanent high-velocity filters are additional features built into the line to reduce maintenance and provide higher operating efficiencies.
Tempromatic Corporation, Drawer 2406, DeLand, Florida.

PORTABLE GENERATOR

Producing 3000 watt of ac power, new Model GW-300 heavy duty portable electric generator provides packaged power on the job site or in other remote locations where electric power is needed. Power is generated by a permanent magnet rotating field. This operating principle is cited as eliminating all brushes, slip rings or commutators. The permanent magnet, internally fan-cooled and corrosion protected, connects directly to the engine shaft with no coupling. Belts are eliminated.

Designated Zeus, the unit is rated at 3000 watt, 115/230 volt, 60 cycle, single-phase. Powered by a rope-started, one-cylinder, four-cycle, air-cooled gasoline engine, the generator will operate for approximately five hr at full load, running on a fuel tank



HERE'S WHY SO MANY ENGINEERS SPECIFY

Phelps Dodge Copper Tube for refrigerating, air conditioning and heating units!

1 Phelps Dodge has complete control of its copper tube from original source to finished product. The copper used in Phelps Dodge tube comes from Phelps Dodge-owned open-pit mines, is smelted in Phelps Dodge refineries and fabricated in modern Phelps Dodge mills. This overall Mine-to-Market control is assurance of highest quality and finest workmanship.

2 Phelps Dodge devotes particular attention, throughout fabrication, to uniform anneal for tube flaring and careful control of die draw for close tolerance.

3 Phelps Dodge can supply maximum tube lengths and precise wall thicknesses engineered to customer specifications; straight length tube tempered to meet bending and expanding requirements.

4 Phelps Dodge multiple mill operation guarantees a steady source of tube supply to meet the needs of manufacturers and distributors of refrigerating, air conditioning and heating equipment.

It's the famous Mine-to-Market Quality Line . . .
sold the quality way—through authorized wholesalers!

AIR-CONDITIONING AND REFRIGERATION WHOLESALERS
ASSOCIATE
MEMBER

PHELPS DODGE COPPER PRODUCTS
CORPORATION
New York, N.Y. • Los Angeles, Calif.

capacity of 2¾ gal. It is equipped with a positive action fuel pump to permit connection to an auxiliary fuel tank of larger capacity.

Two fuses are provided for overload protection. Accessories include an electric starter for automatic starting, electric cord reel for lengths of 100, 250 and 500 ft, auxiliary fuel tank, exhaust extension and a special conversion kit to adapt the unit for butane or propane gas operation.

Borg-Warner Corporation, Pesco Products Div, 24700 N. Miles Rd., Bedford, Ohio.

1961 FREEZER LINE

Five upright and two chest-type models comprise this line of freezers for 1961, featuring "no-frost" in upright models HM-19V and HM-12V. Frost does not accumulate on cabinet walls or packages, since these freezers have no coils, tubes, plates or other protruding elements in the food storage area to collect frost. Metal grilles hold packages stored in the door shelves firmly in place. Built-in dispensers are provided for canned goods and three deep, glide-out basket shelves have open grids to assure constant circulation of air.

Utilized in chest freezer models HI-21H (shown) and HI-17H, a fan is cited as freezing food up to

twice as fast as ordinary freezers by blowing jets of cold air directly against stored food. Defrost water is drained through an easily-accessible drain with hose adapter, located at the front of the unit.

Whirlpool Corporation, St. Joseph, Mich.

EPOXY-CLAD COILS

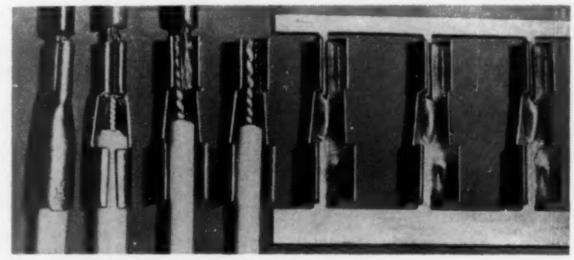
Widest application of these coils is in installations where moisture or condensation are involved, such as in fan coil units. Since these coils are weather-resistant and unaffected by extremes of temperature, they are cited as opening the way for other applications of solenoid valves, such as water towers, crop driers, diesel engines and condensing units.

Coils are line tested at 2300 volt while completely submerged in water, and are available in a wide range of types for 24 volt, 60 cycle; 115 volt, 50/60 cycle; 208/230 volt, 50/60 cycle; or 115/230 volt, 50/60 cycle.

Jackes-Evans Manufacturing Company, 4427 Geraldine Ave., St. Louis 15, Mo.

SPLICE CONNECTOR

Advantages cited for this connector for use in joining heater wire to stranded wire include: no more open



circuits, removal of physical strain from the electrical joint by means of two lances which grip the heater wire insulation, rapid visual inspection of joint through a window in the connector and pull-out strength of 12 lb min. Heater wires from 0.085 to 1.25 OD and stranded wire sizes 14 to 18 can be accommodated by the connector.

Berg Manufacturing Corporation, Truon Div, New Cumberland, Pa.

BACK PRESSURE REGULATORS

Four and six-in. sliding gate back pressure regulators are now available in capacities of 50,000 lb steam per hr or 2500 gpm of water. Sliding gate and plates used in both the pilot and main valve give accurate regulation, tight shut-off and min maintenance. Self-lapping and self-cleaning seats are cited as providing better control over plant operations. Pressures to 250 psi wsp and temperatures to 500 F can be accommodated. Main valve is available in cast iron with 125-psi ASA flanges or ductile iron with 150 or 300-psi ASA flanges. The pilot is a standard screwed-end control valve with special seats.

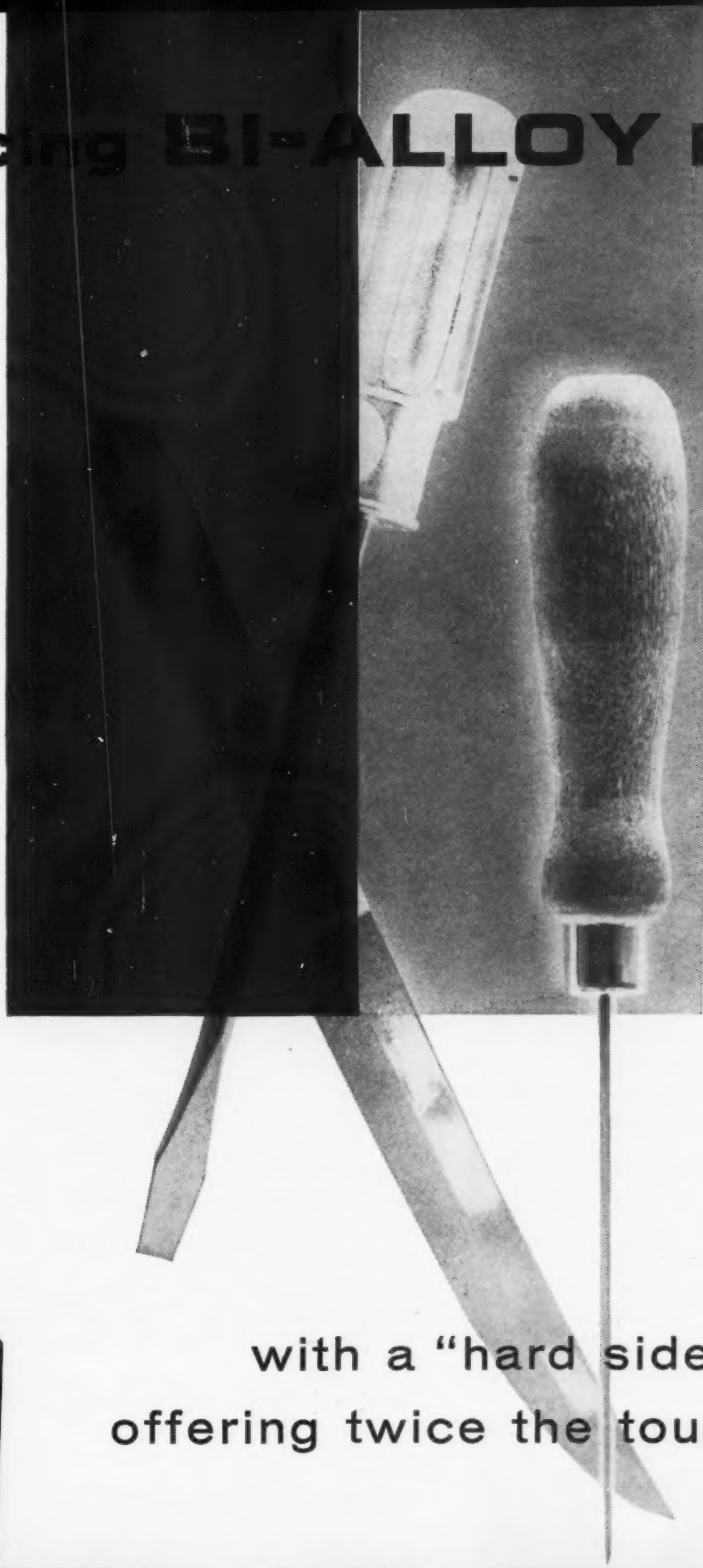
OPW-Jordan Corporation, 6013 Wiehe Rd., Cincinnati 13, Ohio.

TRANSMITTING INDICATOR

Combining the functions of an indicating rotameter and a pneumatic transmitter, the Magnarator measures liquid or gas flows and is cited as being accurate to within 1% over a range of ten to one. In operation, the flow travels vertically upward through the metering tube, which has no recessed or stagnant areas. Assuring a positive continuous bond is the fact that the float in the metering tube is coupled magnetically to a rotating follower in the pneumatic transmitter. Flow rate and the transmitted pneumatic signal, which is linear, are indicated on a dual reading four-in. vertical output scale.

Transmitter can be used with any metering tube ½ to two in. diam, covering flows equivalent to one to 100 gpm water and four to 400 scfm air. Metering tubes and floats are manufactured from a choice of

Introducing BI-ALLOY Roll-Bond



Another Roll-Bond product introduced First by Olin Mathieson

As its name implies, Bi-Alloy Roll-Bond material is made of two different aluminum alloys—one offering about twice the yield strength. The tougher side protects the built-in tubing from accidental puncture, abrasion, and just plain rough handling during fabrication and use. This material has proven itself in many thousands of units in use for over a year.

Keep Bi-Alloy Roll-Bond material in mind for design applications demanding an unusually tough aluminum sheet with built-in tubing for carrying fluids, air, gas, or wires. For complete details, contact Olin Mathieson, Metals Division, Roll-Bond Products, East Alton, Ill.

with a "hard side" offering twice the toughness

ROLL-BOND OLIN MATHIESON METALS DIVISION, East Alton, Illinois

Producers of: Roll-Bond, Western Brass and Olin Aluminum

materials of construction, depending upon flow conditions. Steam jacketed and high pressure models and an extension design for use with meters larger than two-in. pipe size are available also.
Fischer & Porter Company, 676 Jacksonville Rd., Warminster, Pa.

DUCT COVER

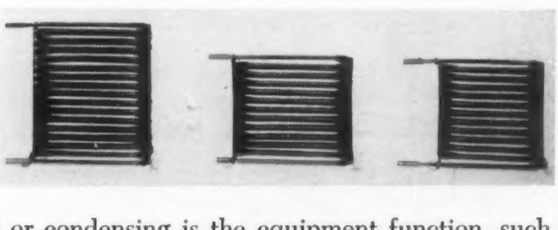
Use of Durethene polyethylene film as a vapor barrier on air conditioning ducts is cited as having proved both satisfactory and advantageous for a supply firm currently utilizing this material for residential and small commercial installations. Using a 1500-ft roll of tubular film, the installer gradually works the tube onto the ducts until they are covered completely. Since the tubed film is seamless, which eliminates the need for taping, the cover is continuous from coil to outlet.
Koppers Company, Inc., Plastics Div, 801 Koppers Bldg., Pittsburgh 19, Pa.

HEAT TRANSFER SURFACE

Made from one length of tubing, which can be formed readily in a variety of shapes to meet requirements of original equipment manufacturers, this newly designed heat transfer surface for refrigeration equipment serves as an efficient condenser. Flat wire is wound spirally as a continuous fin over the entire length of the tube, with tubing size, fin height and spacing variable. Tension is applied to the wire during winding, and the tubing is also under pressure against the wire as it is wound, assuring contact between wire and tubing.

Finned tubes can be wound in a continuous downward direction, allowing for complete drainage at the end of the condensing cycle, as well as unobstructed flow through the unit. Outside diam of the flat wire fin is smooth, resultant increased efficiency allowing wider spacing, which decreases possibility of clogging.

Unit is suitable for application where heat trans-



fer or condensing is the equipment function, such as in air conditioning, refrigeration and heating.
Bootz Manufacturing Company, Evansville, Ind.

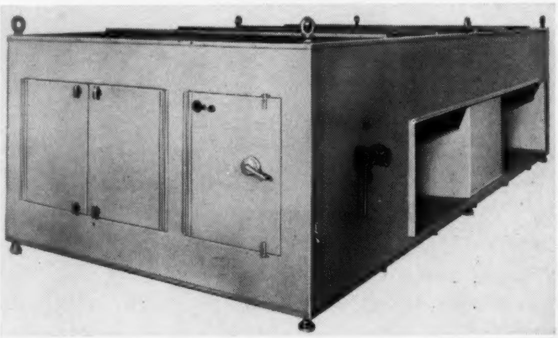
ROOM AIR CONDITIONERS

Extensive flexibility for adapting to a wide variety of installation requirements is a feature of this newly designed series of remote individual room conditioners. Four conditioners are offered in five sizes each, ranging from 200 to 600 cfm and capable of providing individual room control of temperature and humidity in any building with central hydronic cooling and heating systems. Compactness in an 8½-in. width is provided in both concealed and cabinet models. The latter can be semi-recessed up to 3¾ in.

Easily installed and serviced in either floor or ceiling mountings, units have accessible mounting brackets, piping and electrical lines and air vents; and removable filters and motor fan assemblies. Other features are three-speed finger-tip push button controls and such optional accessories as adjustable grilles, auxiliary drain pans, inlet plenums and heavy gauge aluminum wall boxes.
Bohn Aluminum & Brass Corporation, Danville Div, Danville, Ill.

MAKEUP AIR HEATER

Completely packaged, the Champion MA requires no ductwork and operates independently of a present heating system. It is designed for all makeup air requirements, including tempering, drying and humidity control. Unit features weatherproof construction, high available operating efficiency, extensive



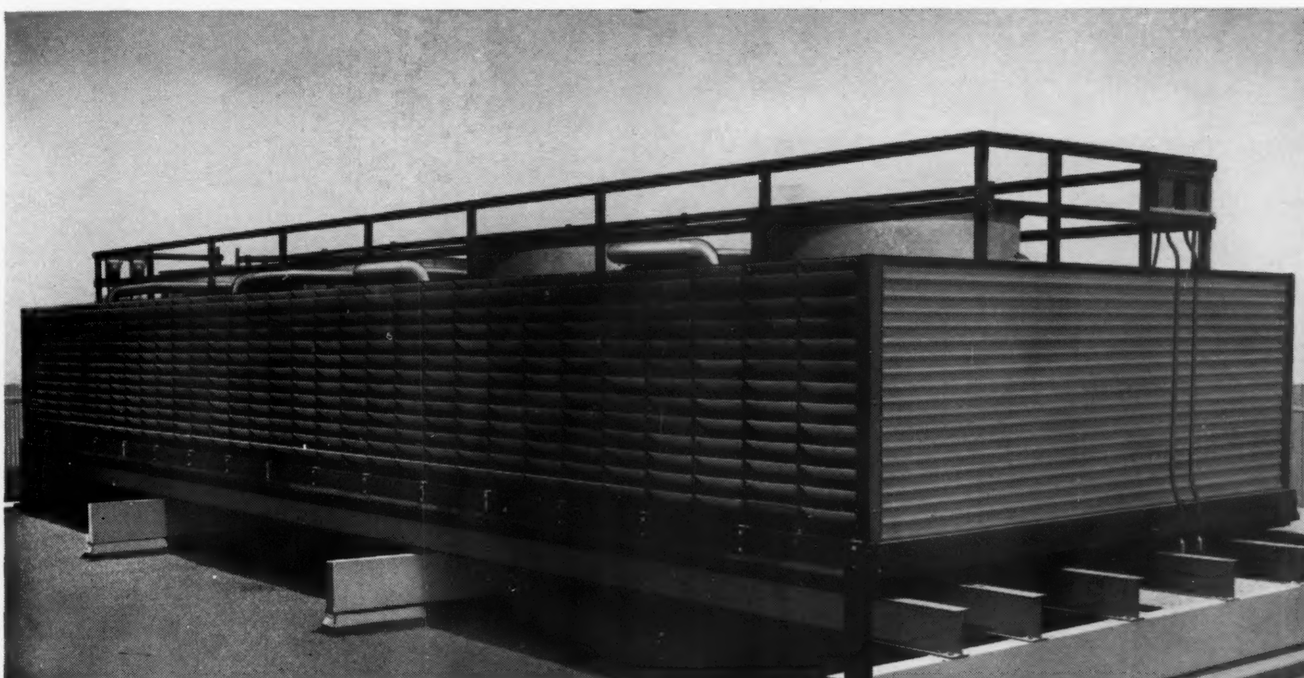
flexibility of installation and discharge arrangements, full modulating air flow mixer and built-in electrical control panel.

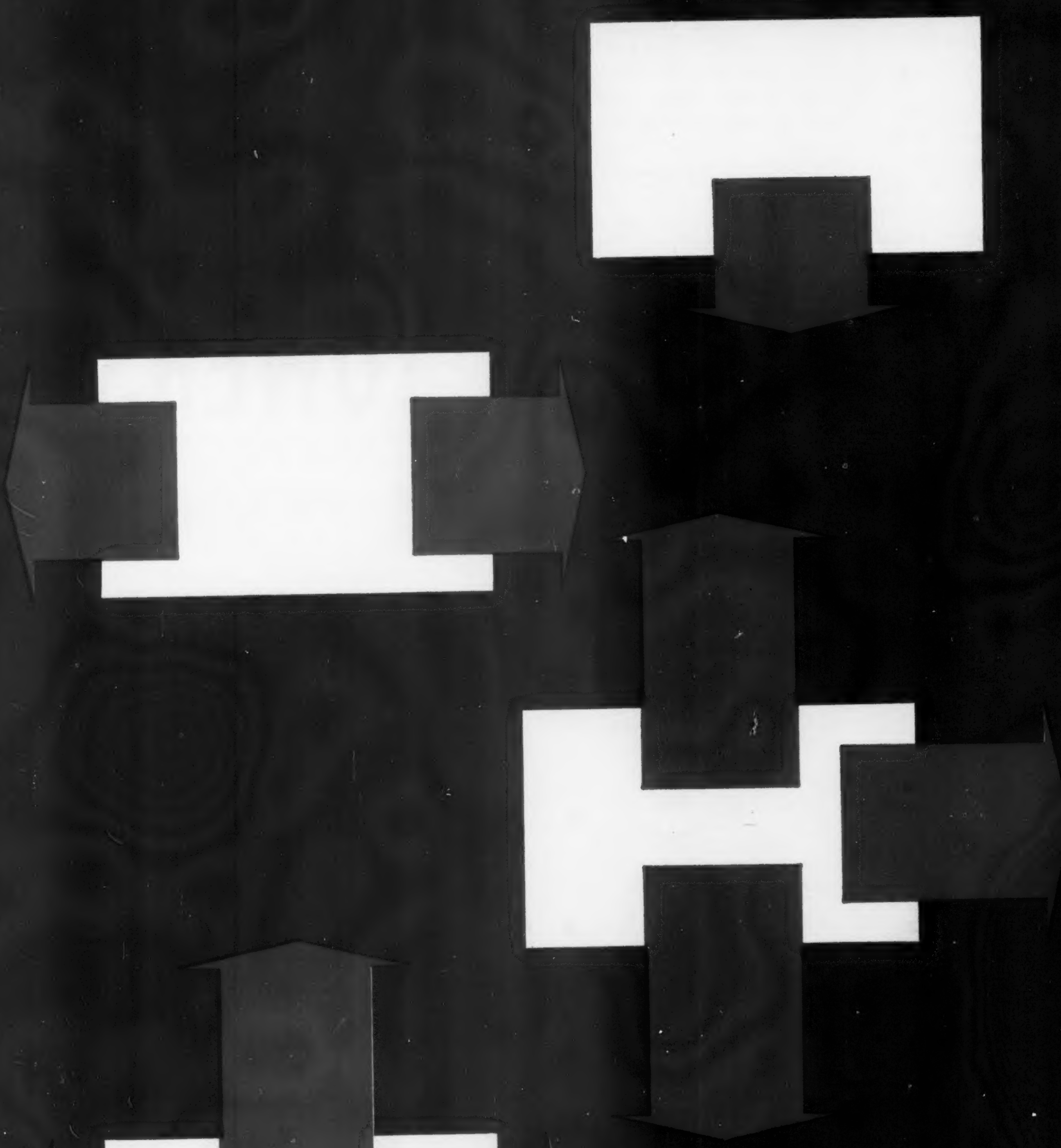
Direct-fired, unit tempers air by passing it directly through the flame. 26 standard sizes range from 8000 to 150,000 cfm. Full modulating turn-down ratio is 25 to one.
National Heater Company, Inc., St. Paul 8, Minn.

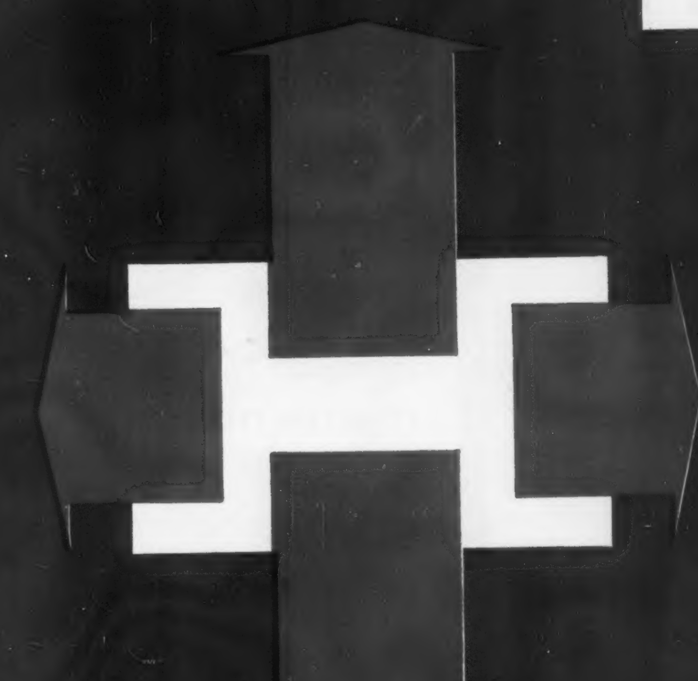
PACKAGE GENERATOR

Comprised of ten sizes ranging from 20 through 100 hp, the 300 Series is a Scotch marine three-pass wet back package generator available in high or low pressure steam or hot water for a wide variety of applications. Rated output of the series is from 670,000 to 3,350,000 Btu/hr. Firing is by either light oil or gas or a combination of the two.

Featured is a separate head for each pass of tubes, cited as eliminating undue thermal expansion and contraction. All tubes in the generator are rolled and beaded (not welded), and are accessible through hinged front doors. The entire boiler has steel jacketed insulation. Cylindrical turnaround design of the boiler removes the necessity for circumferential stays. Large firing tube, coupled with wet back design, keeps the rear combustion chamber cooler.







TYPE M

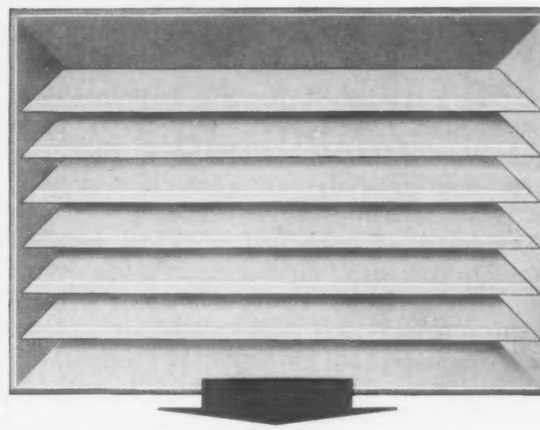
Multi-Pattern Diffusers

The extreme flexibility of

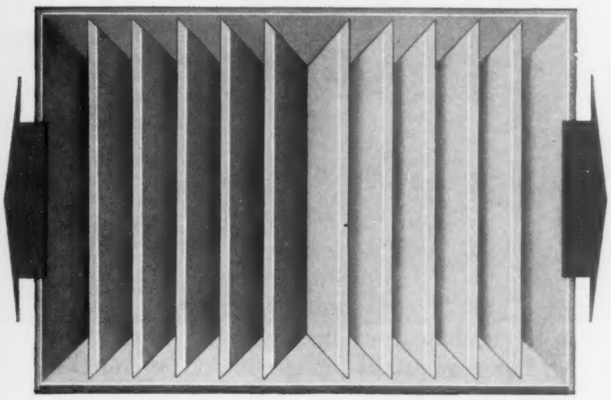
Type M Multi-Pattern Diffusers

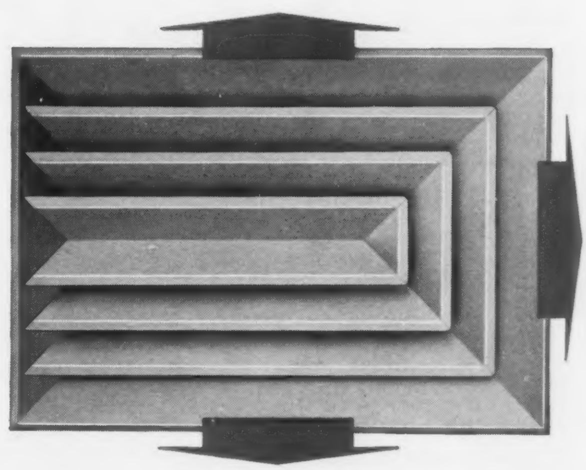
means custom-selected air distribution

TYPE M 1-WAY BLOW

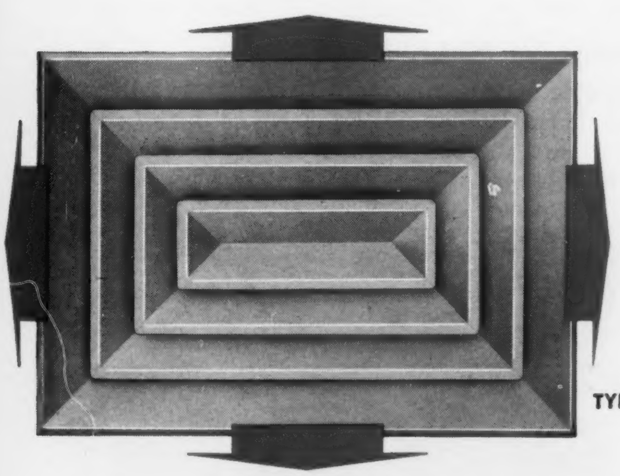


TYPE M 2-WAY BLOW





TYPE M 3-WAY BLOW



TYPE M 4-WAY BLOW

Ideal conditions for the placement of ceiling diffusers do not always exist. Walls, partitions, exposed beams, supporting columns, light fixtures . . . big offices, small offices, corridors . . . are some of the factors that can contribute to the problem of correctly selecting and locating air distribution outlets.

With Tuttle & Bailey Type M Diffusers . . . you can select units that will distribute air in a one-, two-, three-, or four-way pattern . . . and you can select from a wide range of square and rectangular sizes. An added advantage . . . if and when requirements change in the conditioned space, it is an easy matter to install a core with a different air pattern arrangement.

T & B Type M Diffusers are attractively styled and can be furnished with four margin styles . . . beveled, flat, flush, or drop-collar . . . designed for various types of ceiling mountings.

For complete details, see your nearest Tuttle & Bailey Representative or write us direct.

TUTTLE & BAILEY

division of Allied Thermal Corp. New Britain, Connecticut

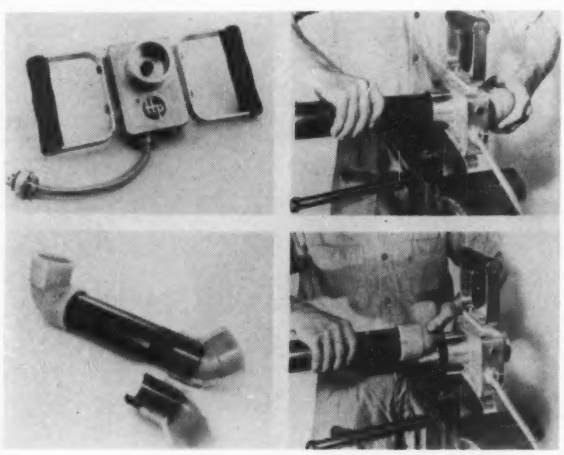
Tuttle & Bailey Pacific, Incorporated, City of Industry, California

Each unit has a water return blending device to distribute water circulation and reduce thermal stress. Integral steam separators are utilized to ensure dry steam under adverse conditions. To achieve equal water distribution in the hot water generators, a manifold pipe connects the return water inlets on both sides of the boiler.
Petro, 3710 W. 106th St., Cleveland 11, Ohio.

HEAT TOOL

Development of a small, portable heat tool to bond solvent-resistant thermoplastics pipe and fittings has been announced by this manufacturer. Unit is effective on such materials as Penton chlorinated polyether, polypropylene and polyethylene.

Designated Thermo-Seal, the tool (upper left illustration) consists of an aluminum assembly with a cast-in tubular electric heater element and two surfaces upon which pipe ends and fitting sockets are heated simultaneously to fusing temperatures. The entire bore of each fitting socket and the mating surface of the pipe are thus heated, after which the parts are removed and joined, cooling to a permanent bond in approximately ten sec.



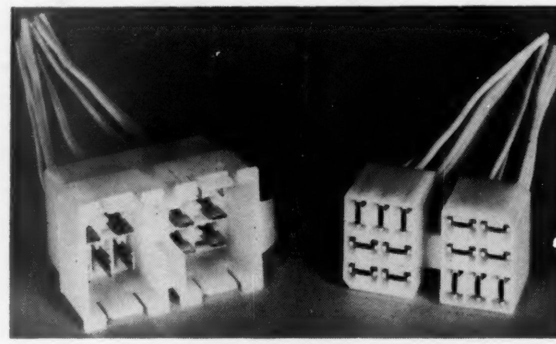
Polyethylene pipe and a socket-type fitting are shown, at upper right in the illustration, being heated and then (lower right) joined. Completed assembly is shown at lower left with a cutaway of the fused joint.
Tube Turns Plastics, Inc., 2929 Magazine St., Louisville, Ky.

MULTIPLE CIRCUIT CONNECTOR

Accommodating 7, 14 or 20 circuits, Ampeez is rated at 25 amp, with an insertion force per pair of contacts of two to five lb. This extremely low insertion force and high amp rating are possible because of flat design of the tab and receptacle.

Advantages of a multiple connector over single-contact units include increased reliability by elimination of the human error factor inherent in individual connections and inspection of an entire assembly at one time.

Contacts are housed in nylon and can be molded as a 14-circuit housing, two separate symmetrical 7-circuit housings or a 20-circuit housing. Connectors are front-entry panel mounted. Receptacle contacts are of brass, with either a plain or tinplated finish and a large bell-type mouth to permit easy tab entry.



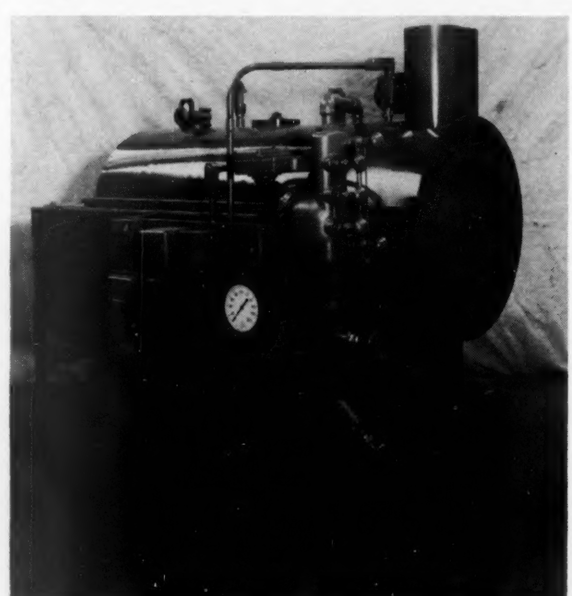
AMP, Inc., Harrisburg 30, Pa.

BASEBOARD HEATER

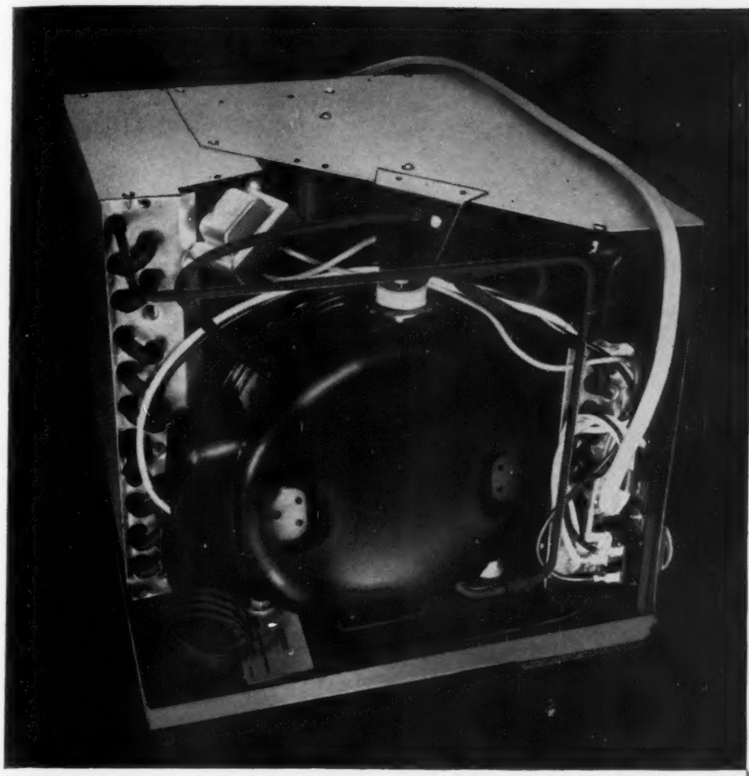
Developed for use in bathrooms, this electric glass radiant baseboard heater is rated at 600 watt for operation on either 120 or 240 volt. Because of their great output of infrared heat and location close to the floor, the units warm normally-cold bathroom tile floors. No fan is required for circulation, eliminating drafts. Featured is a built-in automatic thermostat.
Berko Electric Manufacturing Corporation, 212-40 Jamaica Ave., Queens Village 28, N. Y.

PACKAGED BOILERS

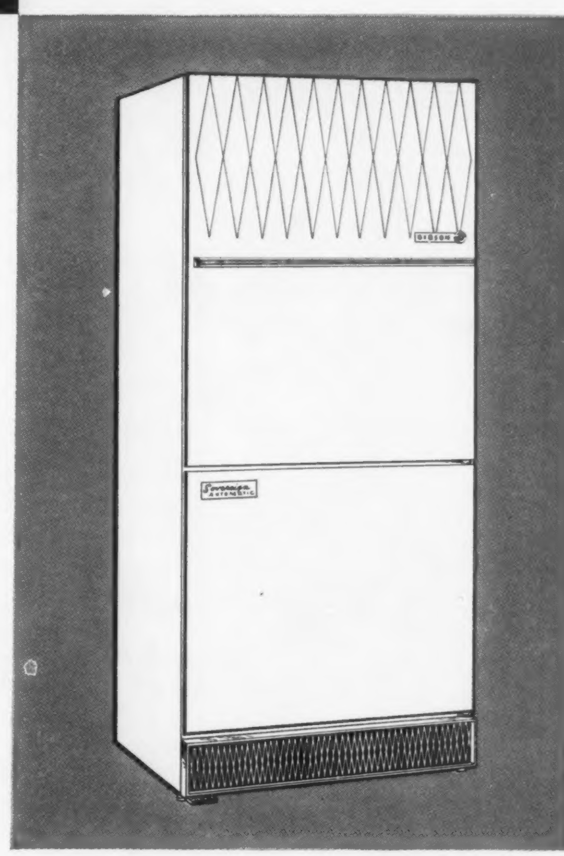
Available in sizes from six to 100 hp, these fully packaged horizontal return tubular-type high pressure boilers are shipped assembled, wired and with all controls pre-installed at the factory. Units are available in models for firing with light or heavy oils, with gas or interchangeably with gas or oil.



Columbia Boiler Company of Pottstown, Pottstown, Penna.



WOLVERINE refrigeration tube contributes to Gibson dependability



One of America's fastest growing refrigeration and air conditioning names is that of Gibson Refrigeration Division of Hupp Corporation, Greenville, Mich.

Gibson is widely recognized for the quality of its products and for its unique and aggressive merchandising of its extensive refrigerator, freezer, air conditioning and dehumidifier line.

Each year, Gibson uses tens of thousands of feet of Wolverine copper refrigeration tube in the production of its evaporator and condenser coils. Gibson also specifies Wolverine Capilator® as the capillary pressure reducing tube between these coils.

Like other leading American manufacturers, Gibson Refrigeration Company knows that it can depend on the constant high quality which Wolverine Tube Division of Calumet & Hecla Inc., builds into its tubing.

Your company, too, can benefit from Wolverine Tube's sound engineering, years of experience and the overall Tubemanship of its skilled employees. Next time you order copper, copper alloy or aluminum tubing–specify Wolverine. You'll be in good company.

WOLVERINE TUBE
DIVISION OF
Calumet & Hecla, Inc.
DEPT. H, 17244 SOUTHFIELD RD., ALLEN PARK, MICH.
Manufacturers of Quality Controlled Tubing

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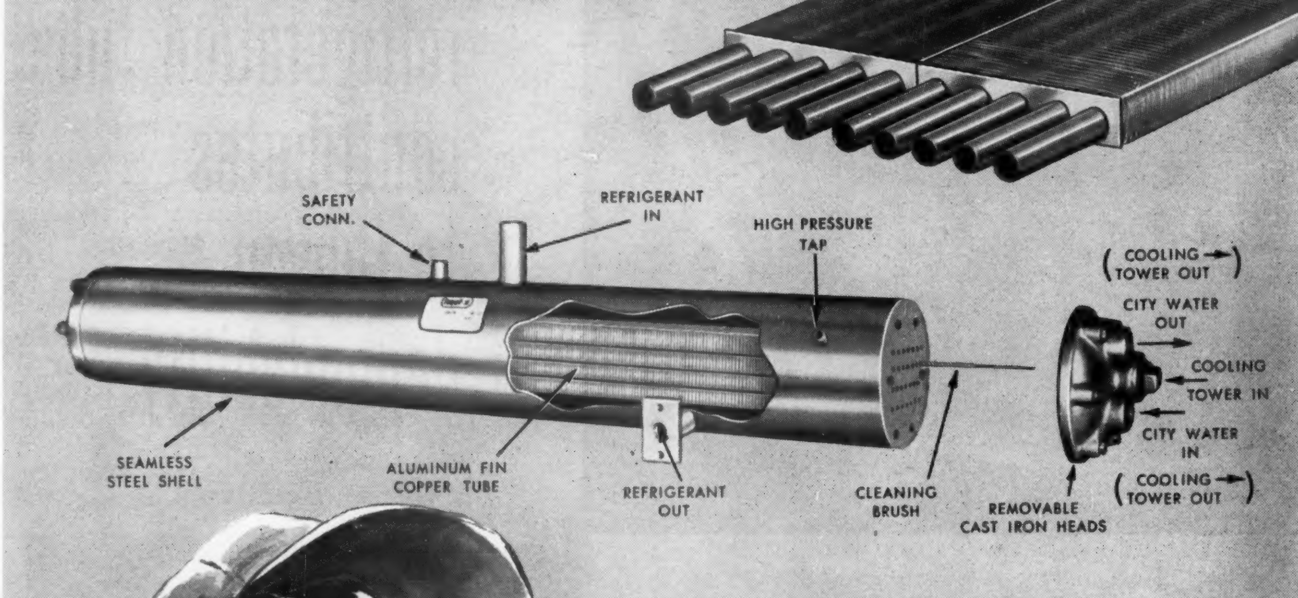
PLANTS IN DETROIT, MICHIGAN AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES.

There is a difference in shell and tube condensers!



'CSTC' CLEANABLE SHELL AND TUBE CONDENSER

IT'S EXTENDED ALUMINUM FIN SURFACE

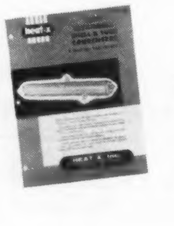
And this superior construction—exclusive with HEAT-X—makes a big difference . . . makes possible

- Greater heat transfer efficiency.
- Better gas distribution across the cooling surface.

These heavy duty, high capacity condensers are specifically designed to simplify the mechanical cleaning necessary in areas where poor water conditions exist.

Internal condenser rigidity is assured by combining five tubes to a "bank". These "banks" are securely bracketed internally to provide a rigid, vibration-free bundle.

Units are available in a wide range of sizes, 5 through 100 tons.



REQUEST FORM NO. 8044

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DUNHAM-BUSH, INC.

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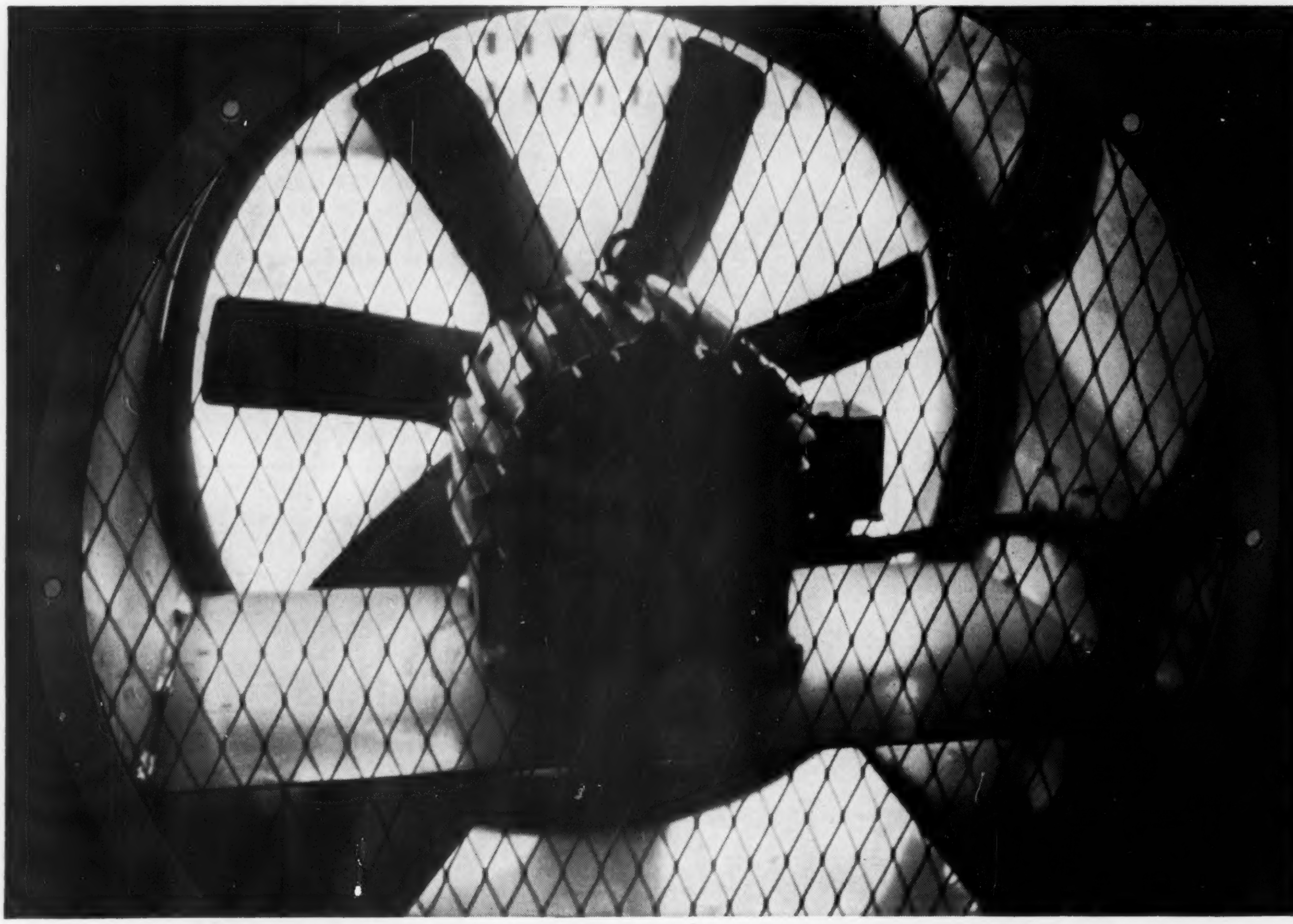
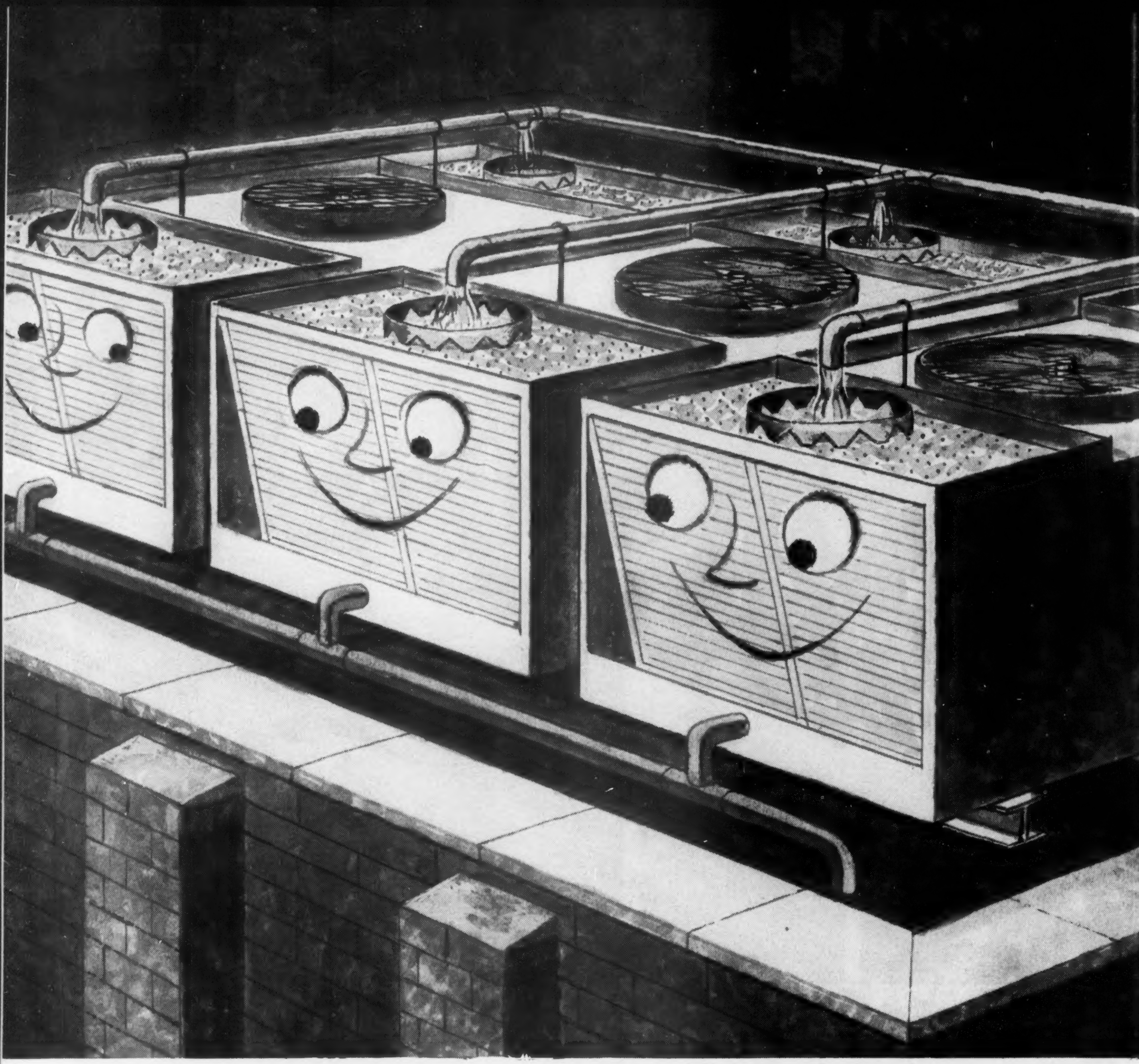


PART AFTER PART, quickly produced at minimum cost and with minimum rejects, comes naturally when you plan using Chase Copper Tube. Bends shown courtesy of Elkhart Products Corporation.



JOURNAL
OFFICIAL PUBLICATION
DECEMBER 1960

Metastable state of water in relation to

Heat exchangers

Investigations were carried out in an effort to determine whether conditions associated with the metastable state might produce explosive actions of sufficient intensity to cause rupture of boiler walls or piping equipment. Evidence obtained rather strongly indicated that serious damage from this was highly improbable, but under conceivable circumstances, not impossible. After a careful search of the literature, a number of experiments were carried out. This investigation which was started at the request of the Technical Advisory Committee on Hot Water and Steam Heating* took place at Northwestern University as a cooperative research investigation sponsored by ASHRAE.

BURGESS H. JENNINGS
Presidential Member
Fellow
ASHRAE

GENERAL PATTERN OF METASTABILITY

Tables of the properties of fluids have been prepared for almost all of the substances in common use, such as water-steam, refrigerants, many hydrocarbons and other organic liquids. Such properties always indicate the temperature-pressure (t-p) relationships which indicate equilibrium saturation conditions. For example, with water-steam (H_2O), appropriate tables of the properties of steam (Ref. 1) would show that at 14.696 psi pressure, a temperature of 212 F must be reached before boiling takes place. The term boiling, as used here, means the orderly phase change associated with a liquid transforming into vapor (or the reverse of vapor condensing into liquid). Similarly, at 100 psi, the boiling temperature is 327.8 F; at 200 psi, 381.8 F; and at 400 psi, 444.6 F. The question, why these particular values might be raised and is it always true that for water-steam the values are invariant? Although these values are those of equilibrium and statistically probable, it is possible for aberrations from these normal values to exist. Moreover, when a fluid has deviated from its equilibrium properties in relation to phase change, it is not completely stable, and it has become the custom to speak of the fluid as existing in a state of metastability.

It has long been recognized that, although equilibrium conditions, as indicated above, are the most usual and relatively stable conditions, it is possible for water to exist in other configurations. This is true not only with the phase change relating to evaporation but also with the phase change which occurs when a liquid solidifies.

For example, it is not difficult to chill water carefully to temperatures below 32 F without the formation of ice. Normally, when heat is abstracted from water which has reached 32 F in temperature, ice starts to form and further heat extraction results in the formation of more and more ice, with the temperature remaining at 32 F, until all of the liquid has turned into solid after which, if further heat is abstracted, the temperature of the solid then falls, with cooling occurring in the solid phase.

Sometimes, however, if the heat abstraction takes place rather slowly and quietly, the liquid, on cooling to 32 F does not change

*John W. James, Chairman
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M. W. McRae
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Benjamin Spieth
M. H. Westerberg

B. H. Jennings is professor of Mechanical Engineering, Northwestern University, and Part-time Director of the ASHRAE Research Laboratory. This paper was prepared for presentation at the ASHRAE Semiannual Meeting, Chicago, Ill., February 13-16, 1961.

phase as further heat is abstracted, but readily drops in temperature to values as low as 24 F; even reaching 20 F. If, however, this liquid, subcooled below 32 F, is disturbed by stirring or other shock, the metastable state is upset, ice crystals form throughout the mixture, and the temperature immediately rises to 32 F, with normal freezing again taking place. Even when no forced disturbance takes place in the subcooled water, usually at about 8 to 12 deg below 32 F the unstable state rectifies itself, the mixture forms ice crystals and moves back to equilibrium or to what might be considered the most stable form.

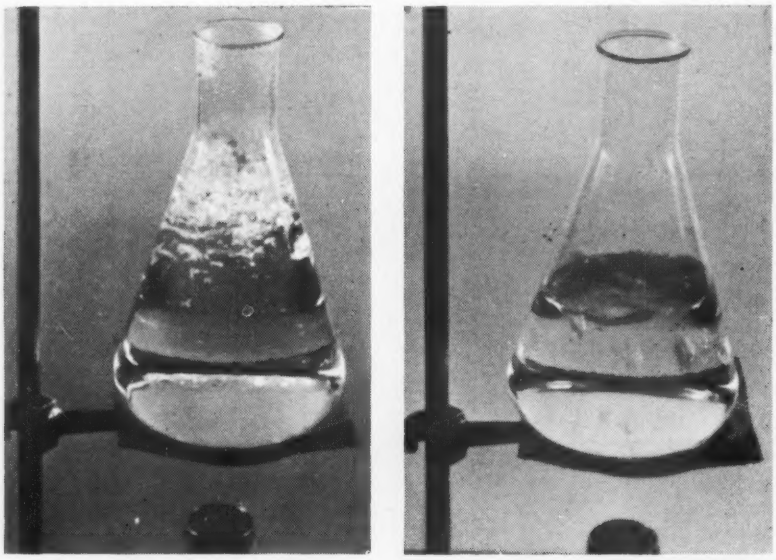

Fig. 1 Water boiling in flask under normal conditions (left). Metastable boiling of gas-free water (right)

This condition of metastability, in relation to the phase change from liquid to vapor, occurs in somewhat similar fashion because, if gas-free water in a smooth-surface vessel is quietly heated, it is possible to raise the temperature of the water far above the normal equilibrium pressure and temperature. That is, in an open vessel, water (at 14.7 psi) reaching the 212 F temperature will normally boil, but occasionally it may stop boiling and rise in temperature 2 or 3 deg above 212 F, after which stabilization will occur; and temperature drops back to 212 F.

If care to add heat at a uniform and slow rate is exercised, the same pattern applies, but temperature increases of 12 to 15 F above equilibrium occur before readjustment. This phenomenon can be observed with ordinary glass or metal vessels, provided they have smooth walls. Using water in a capillary tube, Kenrick, et al, (Ref. 3) were able to heat water to a metastable temperature of 518 F at atmospheric pressure. The work of Kenrick took place under conditions that would not be applicable to engineering operations.

The process of bubble formation in a liquid is a complex problem which is closely related to surface tension of the liquid, as well as the other factors of phase change. Surface tension naturally resists the bubble formation and is thus important in the boiling process. The equation expressing the relationship between the pressure inside of a bubble and the surrounding liquid is developed in most thermodynamics texts[2] and in treatises on physics. In simple form it appears thus:

$$\Delta p = \frac{2s}{r}$$

where Δp represents the pressure difference between that inside of a bubble and that outside of the bubble in contiguous superheated liquid; S is the surface tension of the liquid; and r is the radius of the bubble. With quite small bubbles where r is only a micron or so, calculation will show that the pressure differential can approach values reaching to hundreds of psi. Surface tension decreases with increasing temperature of the fluid and reaches a value of zero at the critical temperature.

These comments are not intended to create the impression that boiling a liquid is a difficult problem, because it is not the case. Nevertheless, if it were not for a number of compensating features, the boiling process would be much less satisfactory in equipment than we find it to be. As has been mentioned, boiling is helped by dissolved gases, and by the convection currents, which in connection with surface roughness can alter flow to the point of making boiling less difficult. During the boiling process some superheat (metastability) always exists in the liquid.

A corollary to boiling is the problem of effervescence in liquids which are saturated or supersaturated with gas. This condition exists in carbonated beverages, where it can easily be observed that if the bottle containing the beverage is vigorously shaken, a rapid and intense release of the gas from solution takes place. This is similar to what happens when bubbles form in a superheated liquid, for, in this case also, the generation of bubbles is accelerated whenever the body of the liquid is disturbed.

EXPERIMENTATION IN GLASS VESSELS

The first phase of the investigation involved laboratory studies designed to see how readily the metastable state could be produced. A series of experiments was started with the work being done completely in glass. As has been mentioned, in ordinary boiling the process is greatly helped by gases dissolved in the water, and it is also aided by surface roughness of the vessel which contains the water.

Chemists, for example, often put glass beads in the bottom of a beaker undergoing heating, for this practice promotes smoother boiling. A conclusion from this would be that both the rough surface of the beads and bubble nuclei on the surface of the beads act to promote bubble formation and smoother boiling. It is true almost without question that bubble nuclei adhere to the surface of such beads, exist-

ing in the form of adsorbed gas. There is, however, strong doubt that beads or other objects, because of surface effects or rounded points, contribute to bubble formation. In fact, it is possible to observe sharp points, broken glass lying in the bottom of a beaker, and to note that there is more evidence of bubbles being formed on the smoother surfaces of the glass than at the points.

If such broken glass or beads are completely boiled out to the point of being essentially degassed, they apparently are not particularly effective as bubble inducers. It is in another way that the beads serve in the formation of bubbles, because superheated (metastable) water has difficulty maintaining its superheated or metastable condition if the water is agitated as by continual stirring or rapid motion. In an assemblage of beads in the bottom of a beaker, it is true that thermally-actuated convection currents are necessarily active, and the scrubbing or convective action of the currents over the surface of the beads acts to cause bubble formation from the resulting turbulence.

In carrying out early testing, distilled water was put into Erlenmeyer flasks and boiled for a long enough period to remove the greater portion of the dissolved gases in the water. The only difficulty encountered was to prevent all the water boiling away before the gases had been removed. After some trials, it was possible to accomplish this, and an almost completely degassed water was obtained. When the rate of heating the water was then greatly reduced, boiling in normal fashion would stop and the condition of metastable boiling which is also known as boiling with bumping began.

Under boiling with bumping, the water no longer boils at equilibrium temperature but tends to rise a few degrees above equilibrium. Following the temperature rise, a readjustment takes place and vapor forms with sufficient violence to jar the container and create an audible sound, which explains the name attributed to this type of boiling.

Considering normal atmospheric boiling temperature of 212 F, it is possible, in an open flask of this type, using a Bunsen burner, to reach metastable temperatures as high as 218-220 F. This appeared to be the top limit which could be reached in a simple trial of this type using a Bunsen flame in an open room.

Fig. 1 is a picture of two Erlenmeyer flasks operating under similar conditions. At the left, water is shown being heated and boiled in normal fashion. This involves ebullition in the true sense of the word; that is, a number of bubbles move throughout the mixture, steam is released at the upper surface and passes out to the top of the flask. At the right, metastable boiling is taking place. This involves a surging action in the liquid, and the liquid appears to swirl around. Almost no bubbles are present, and steam leaves the water surface in limited amounts.

Following the tests with distilled water, a number of similar tests were made using ordinary city tap water, as there was doubt whether tap water with 100 to 200 parts per million of solids in solution, and possibly more gas also in solution, would behave in a fashion similar to distilled water. The investigations showed that city tap water behaved in almost the same manner as distilled water and, in a superficial way, showed the same limits of metastable temperature rise.

The third step in this program with glass was to set up a more carefully controlled environment for heating in order to find out what limit of metastable temperature rise might be reached. For this purpose, a circular well-type structure some 6 in. high was built, into which the flask could be placed, and inside this space a number of radiant electric heaters were inserted. The character of the enclosure and the heaters can be seen in Fig. 2, with a flask in position.

For this part of the investigation, a flask, partially filled with degassed water and at boiling temperature, was moved into the container and subjected to continued heating from the radiant electric heaters. Using these, the controlled heat input largely entered from the sides of the flask. Without much difficulty temperatures as high as 228 F could be reached under free atmospheric conditions. This represents a 16 F metastable temperature rise over normal boiling temperature. At these higher temperatures, it became increasingly evident that the return to equilibrium, when it occurred, was usually violent.

Fig. 2 Flask of water boiling under metastable conditions, using side radiant heating

Moreover, some event was usually needed to trigger the return to equilibrium; and having learned this, a better basis of test control was established. For example, if metastability were present, when the water was stirred by a thermometer to take a temperature reading, the metastable state would be immediately upset. It was found that such stirring was inadvisable, as a scalding jet of water shot from the flask as the return to equilibrium took place. Consequently, two other methods were used to trigger the return to equilibrium. The first was to stir the water with a hooked wire when the upset was desired, and the second was to drop a small pellet into the flask to cause the same result.

Fig. 3 shows what can happen when this return to equilibrium occurs. This is a synchronized photograph, which followed the dropping of a pellet in the flask when the water temperature was at approximately 227 F. The water in the flask re-established equilibrium with great violence, forming steam and throwing water and steam upward about 5 ft, sufficiently high to wet the ceiling of a 9-ft room. Although it was difficult to photograph this result clearly, the streaks indicating the water and steam being expressed to the ceiling are clearly visible in the photograph.

TRIALS IN PRESSURE VESSELS

The next phase was to investigate metastability in closed metal vessels at greater than atmospheric pressures. Here the problem of degassing the water and of having the metastable state exist with water contacting rough-surface metal walls existed. A small bomb-like device was constructed for this. See Fig. 4. It consists of a length of 6-in. pipe capped at one end and provided with a flanged connection on the other end. Into the flange head a diaphragm device was prepared to record pressure surges and a mercury manometer was connected. A Bunsen burner heated the liquid contents through the container walls of the vessel, a bare thermometer also dipped into the liquid contents, and arrangements for filling and emptying the tank with appropriate valves and tubing were also provided.

In operation, the tank was essentially filled with previously degassed water which was heated and further degassed by venting off air and steam from the container. A small amount of make-up water was added to replace the amount which had been boiled off and the process repeated several times until it was felt reasonably certain that the liquid in the vessel was essentially gas-free. At this point a metastable investigation could be started, and when water almost completely filled the chamber, the liquid was heated to a temperature of approximately 240 F; heating was then stopped. The temperature of the water and the pressure indicated by the mercury manometer were both carefully noted.

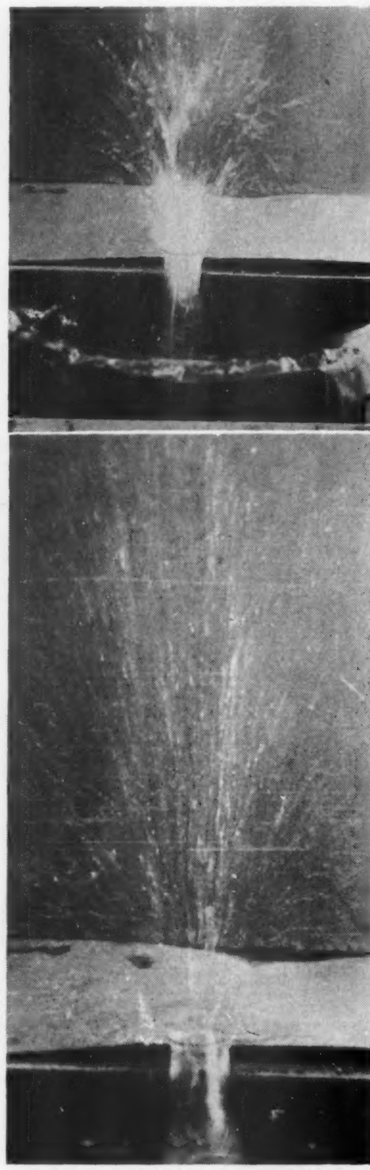

Fig. 3 Triggered explosions of metastable water from a flask surrounded by radiant heaters

Cooling of the uninsulated chamber immediately set in, and the question at hand was whether a metastable condition existed in the chamber. Corresponding readings of pressure and temperature showed deviations from equilibrium which were not particularly different, and cooling and pressure drop occurred at a slow rate. It was noted that the attached mercury column instead of dropping uniformly would sometimes undergo an oscillation and then continue its uniform descent. While researchers wondered what caused this oscillation, the pipe was inadvertently jostled: it was noted that an abrupt and sharp oscillation in the mercury column took place.

Further investigation showed that during the cooling process if the vessel were sharply struck by an object, such as a block of wood or hammer, an oscillation in the mercury column nearly always followed. However, once the oscillation had occurred, striking the vessel a second time produced no effect; that is, apparently a metastable state existed in the liquid during the cooling process which, disturbed by the shock, brought the system immediately to equilibrium, and equilibrium having been established, further striking of the vessel showed no pressure surge effect.

This phenomenon was easily reproducible and all that was required was gas-free water and a cooling process of the type described. The amount of water in the tank was found not to be critical, but a vapor space was always provided. Actually, the fuller the tank the more violent the shock effect, the extent of which, measured by the mercury manometer, was only 2 to 5 in. of mercury in magnitude. Shock effect (short-time pressure peak) from a metastable state to equilibrium is of greater magnitude than this, but for the low temperature differences involved, the resultant pressure surge will probably always be small.

Consequently, the pressure diaphragm which had been placed on the flange was not usable, as its stiffness ratio had been set for significant deflection in a range for pressure differences of 25 psi or more. Note that either distilled or tap water could be used interchangeably in the pressure vessel and that the same type of results were obtained. Thus, there was no evidence that material in solution in the water prevents the condition of metastability.

In summary, this vessel had shown data of the following type:

Warming at 240.0 F at 51.0 in. Hg (essential equilibrium)

Cooling in 236.0 F at 46.1 in Hg (1.2 in. unbalance indicated)

Striking the vessel in the range of 236 F showed distinct oscillations of the mercury columns reaching about 2.5 in. per leg from the undisturbed state

Striking the vessel immediately after such a readjustment showed trivial oscillations, about 0.3 in. per leg max

Oscillations in reducing magnitude (i.e. less than 2.5 in. per leg) as the temperatures fell toward 212 F and the vessel was struck

Mild oscillations in the subatmospheric region continued to some 190 F (about 0.2 in. per leg)

Manometer oscillation from straight mechanical shock with cold water in the vessel were hardly noticeable and the movement was 0.1 in. per leg or less

The results of this work were sufficiently encouraging for the existence of the metasable state, to indicate that further work should be carried out. The vessel described, because of its limited liquid volume, the high heat capacity of its walls and the necessity of redesigning its temperature-pressure measuring system if precise indications were to be obtained, was redesigned for continuing the investigation.

Because a somewhat practical device was desired, an ordinary 30-gal galvanized-iron, hot-water domestic service boiler, provided with pressure taps, filling and venting devices, an electric heater, and with essentially the same items that were provided for the original pressure bomb, was used. Previously degassed water filled the tank, and there was great care to further degas the water in order to produce the proper environment for metastability.

The unfortunate fact is that metastability could not be found to exist. This conclusion was reached only after three months of intermittent testing, in which every conceivable means was tried in an effort to show the existence of metastability. Whether the relatively rough inside surface of the galvanized metal resisted degassing so effectively that metastability could not occur, or whether some other condition prevented its appearance, the fact remains that it was not possible to show any evidence of the phenomenon. Consequently, with some regret, the test on this tank was discontinued and another design was planned and made.

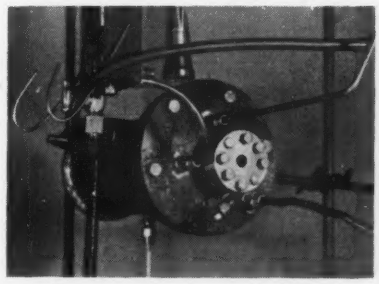

Fig. 4 Pressure vessel employed in metastable water tests

Rough surface was suspected to be a significant factor, so the next step involved a structure built from a smooth-walled material. For this purpose a vertically mounted piece of 4-in. ID brass pipe was selected. This was 36 in. long, and the ends were closed by brazing a ¼-in. brass plate to each end.

Heating was produced by a 25-watt electric heater screwed into the tank through a tapped opening in the bottom plate. The heating rate was controlled by varying the heater voltage with a variac. The tank was equipped with a thermometer well, sight glass, manometer pressure connection, and with a ½-in. pipe outlet at the top, which ran to a surge or air-venting vessel. Connection to the air-vent outlet was by a rubber hose fixed to a water-cooled glass condenser. The outlet of the condenser connected to a ¼-in. copper tube about 20-ft long, the far end of which dipped into the glass bottle that served as a surge tank.

In operation, the tank was filled with degassed water, and this water was then boiled by the electric heater in the tube vessel. Steam and gases from the water passed up through the condenser where nearly all of the steam condensed, and any steam that was not condensed passed through the copper tube finally to condense in the water of the surge tank.

The prime requirement was to provide water as gas-free as possible, and the arrangement described forced the steam rising from the water surface to reverse its direction until it passed through the condenser. It was felt that air entrained in the water would largely be driven off by continuous boiling. Passing through the condenser, the steam was partially condensed, the condensate ran back by gravity, while the remaining air and steam was forced into the surge tank to bubble through the water in it.

After a long period of boiling, to insure that essentially all of the gases in solution had been removed, all valves on the tank were closed; and the contained water was heated until the pressure reached 50 in. of mercury. This value was used because it corresponded to the max range of the attached manometer. When the pressure was reached, the heater was turned off and the pressure lowered in the tank several ways.

The first method consisted of opening a small needle valve connected to the tank, to allow steam to escape to reduce the pressure gradually to atmospheric. Next the tank transferred heat to the surrounding air and thereby cooled. Another was to cool the tank with forced convection generated by an electric fan blowing on the tank. The final method was suddenly to pour water over the outside of the tank. This produced quick condensation and pressure unbalance beyond metastable effects.

Each method caused a condition which was interpreted as metastable, evident from the sudden surge of mercury in the manometer, which occurred when the water reverted to equilibrium and

produced a sudden rise in pressure as the unbalance corrected itself. It was also found that, in the case of the tank slowly cooling, if the outside were tapped, the metastable state would be disturbed and a surge of pressure, amounting to a total of 8 in. of mercury, appeared in the manometer.

When the tank was allowed to cool, without being struck externally, the manometer would surge periodically indicating that the cooling process was not a continuous line of equilibrium states but rather an alternation of metastable and equilibrium states as the cooling proceeded. The pressure rises observed under normal cooling without upset were approximately half as great as those which occurred when the tank was struck.

Runs were made with the water level in the tank at different positions, from almost full to 50 per cent vapor space by volume. Magnitude and intensity of the surges were not altered in relation to the amount of water in the tank. Magnitudes of the surges are thought to be higher than indicated on the mercury manometer, but it is doubtful that they are greatly in excess of those indicated. Considering the smallness of the metastability surge, it was not felt necessary to develop a low-pressure, precision-diaphragm pick-up for the pressure measurement.

METASTABLE CALCULATIONS

A study of energy conditions in metastable water can be readily made with the help of the steam tables, and the results of such a study are shown in Fig. 5. This figure is set up for atmospheric pressure and on the assumption that the specific heat of superheated water is not seriously different from saturated water in the same temperature range. The surplus energy of superheated water over that of saturated water at the same pressure has been plotted. Thus, at 212 F, equilibrium exists, and no surplus energy is indicated. If, on the other hand, the water when heated to 220 F remains as a liquid, it will have picked up 8.0 Btu/lb or approximately 6300 ft-lb of excess energy. Similar values appear on the chart for higher temperatures.

When metastable water at a 200 F temperature is triggered, and it flashes to water and steam at equilibrium temperature (212 F), the surplus energy serves two functions: First, to change the phase or provide the internal latent heat for the vaporizing portion of the water; second, to perform the external work required as the vaporized water reaches its equilibrium volume.

For example, at 220 F, water at atmospheric pressure in flashing would increase in volume by 0.022 cu ft/lb, assuming the volume in-

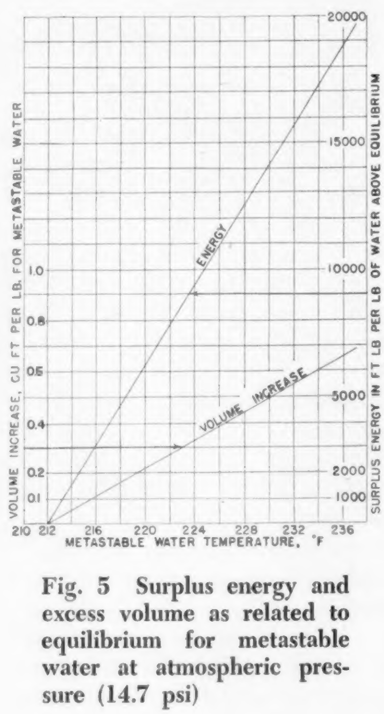

Fig. 5 Surplus energy and excess volume as related to equilibrium for metastable water at atmospheric pressure (14.7 psi)

crease to take place at atmospheric pressure. The external work, as the medium expands, amounts to 47 ft-lb/lb. This value in one sense is a measure of the work produced in readjustment from the metastable condition. However, it does not truly measure the work function, and for this purpose it is better to make use of the so-called availability function:

$$\Delta B = (E_2 + p_0 v_2 - T_0 S_2) - (E_1 + p_0 v_1 - T_0 S_1)$$

which is applicable to a process of this type. Its use is explained in advanced thermodynamics books such as Ref. 5 and Ref. 6; and if this function is evaluated for the same conditions, it is found that the max useful work, derivable from this change of state, amounts to some 39 ft-lb/lb. Although this numerical illustration was worked out for atmospheric pressure conditions, similar patterns would apply for higher pressure levels.

In terms of energy relations for water and steam, these work values are relatively small and lead one to believe that the resultant energy releases under metastable return to equilibrium are also small, so that the pressure rise in a restricted system would not be of great magnitude. However, if exceptionally high metastable temperatures did occur, the conditions would be quite different, as the reestablishment of equilibrium could induce a severe pressure rise or surge followed by readjustment to a final equilibrium pressure higher than the initial metastable pressure.

Consequently, it is not difficult to imagine conditions under which a steam boiler or a water heater could operate for a sufficiently long period that the resultant water could be almost completely degassed; and if the same degassed condition were true for the boiler surfaces, true metastability might arise. If the metastable temperature spread were large, a significant shock could occur. However, the experimental realization of such conditions is so difficult as to indicate that a metastable explosion in severe form is highly improbable.

CONCLUSIONS

Two things are evident from these tests. First, in normal cooling, the metastable temperature was never many degrees away from that corresponding to pressure equilibrium; second, the magnitude of the shock is relatively small, probably in every case less than 5 psi.

The reason for this investigation was to determine whether metastability created a danger or hazard in the operation of equipment. For the following reasons it does not:

1. Most actual installations contain so much gas in solution in the water that the requirements for serious metastability are not present.

2. With quite rough surfaces,

we were unable to show the presence of metastability.

3. The magnitudes of the pressure changes that we experienced were in general below those that would be expected to lead to failure.

However, on the other side of the question, it must be stated that pressure pulses can be caused by metastability; and it is possible to imagine a set of circumstances under which such pressure pulses could be severe enough to cause damage.

The author has been unable so far to find an authenticated case of rupture of a steam (hot-water) boiler produced by metastability, and this is also true for pressure vessels containing other fluids. However, reports that certain systems do show strong symptoms of metastability have come to our attention.

In one instance, under certain conditions, during the start-up period an evaporator which presumably contained only liquid ammonia, oil and ammonia vapor frequently was subjected to what appeared to be a violent shudder. At this time the evaporator was vibrating, and the pipes connected to it were violently disturbed.

Similar phenomena have been reported for some of the high-vacuum, water-salt refrigeration systems on start-up after a period of non-operation. In the systems described, long periods of operation occurred during which any entrained gas would most likely have been vented or purged from the system, and tube surfaces had the opportunity of becoming relatively smooth or coated.

Time can be a factor in the metastability phenomenon, especially when a liquid close to its saturated condition is suddenly allowed to expand and the consequent formation of vapor is necessary. A number of experimental investigators (Refs. 7, 8, and 11) have conclusively confirmed that the amount of vapor which may be formed is not the amount that would be predicted by equilibrium thermodynamic theory, from which it can be deduced that a liquid core in the flow stream remains in metastable condition while the remainder of the stream undergoes the conventional partial vaporization we have come to expect.

WHO'S WHO IN ASHRAE

Insofar as possible these listings will each appear twice a year

ASHRAE OFFICERS, DIRECTORS, COMMITTEES, STAFF
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REGION AND CHAPTER OFFICERS
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RESEARCH AND TECHNICAL COMMITTEES
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STANDARDS PROJECTS
See page 63, July JOURNAL

INTER SOCIETY COMMITTEES
See page 84, November JOURNAL

CHAPTER PUBLICATIONS AND THEIR EDITORS
See page 72, this issue

ACKNOWLEDGMENTS

This investigation of metastable water was carried out over a considerable period of time with my former close associate, Professor Willard L. Rogers, taking a leading part in much of the original work. In addition to his help, a number of graduate assistants were extremely active and their help is also acknowledged.

Particular thanks are given to Armando Torloni, Milan Jovanovich, and William T. Snyder for their experimental work and analysis. The Institute of Boiler and Radiator Manufacturers was most generous in support of this research. Members of its committees worked closely with the Technical Advisory Committee on Hot Water and Steam Heating and recommended many of the experimental patterns which were followed.

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IBR Coordinates its look ahead

Energetically and incisively probing the future in its various aspects for the field of hydronics, Vice Chairman John E. Reed of the Institute of Boiler and Radiator Manufacturers, set the pace for the Semiannual Meeting of that organization in Absecon, N. J., November 1-3. Speaker Reed, who is associated with both the H. B. Smith Co. and the Sterling Radiator Co., chose as his perspective that of a manufacturer looking forward to a nominal 10-year interval of continuing trends.

In product design and development it was anticipated by the speaker that the present trend to increasing complexity in heavier duty and larger size systems would continue, following the course whose initial impetus was given by automatic firing device controls which led to corresponding automatic protection of heating and cooling operations and later to involved fluid circuits and their interrelated performance.

Again, there is a direct relation between this complexity and the increasing activities of consulting engineers in this field, partly, observed Mr. Reed, because consulting engineers "like" complexity and partly because the future demands such new ideas as will better enable meeting new building construction methods and their effects upon the distribution of heating and cooling effects.

As to smaller devices, essentially the home market, the speaker expressed the thought that this equipment had been improved conspicuously already and perhaps did not offer the same points of decision as with commercial and industrial installations. Here, he would place the emphasis on how to expand the markets for the interval ahead, suggesting promotions to capture additional percentages of the home market from other forms of heating and cooling and offered the specific thought that "shell houses," as a growing trend in construction, may not be presently best served by existing equipment availabilities.

In manufacturing methods and administration, Mr. Reed foresaw the necessity to improve personnel by upgrading wherever possible to meet the new competition of products, equipment, markets, administration and other so-called overhead functions.

In the field of distribution, he paid a tribute to the views of another speaker at this meeting, President Gordon J. Andrew of the W. T. Andrew Co., who spoke eloquently in regard to the functions and obligations of the wholesaler as an integral part of the manufacturers organization and planning and to the necessity for upgrading sales, staffs and agent personnel.

"In IBR and BHC," said Reed, "we have two organizations which have not only met past problems effectively but are organized and prepared to solve the problems of the future." It was the speaker's contention that, concerned though the hydronics group might be with the possible inroads of electric heat, the real problem did not ally with possible or supposed superiorities of electric heat, but rather with the quantity and power of the promotion being put behind the electric way by the electric light and power companies.

Others who spoke at this well attended IBR meeting were: Franklin Greene, Executive Director of the Better Heating Cooling Council; R. E. Ferry, General Manager of IBR; Jerry Hendrickson, Executive Secretary, National Association of Plumbing Contractors; J. R. Schmitt, Executive Director of Plumbing Heating Cooling Information Bureau; and, Chief Engineer J. R. Sward of the IBR Laboratory.

Assistant General Manager of IBR Hilda Eisenhardt reviewed ways in which the future of the hydronics industry could be built constructively through educational processes and the further projection of the IBR educational program.

Research Professor Warren S. Harris of the University of Illinois reviewed the program for the 13th Short Course, related to IBR programs and efforts, at the University and outlined recent developments in the research program as reported upon most recently in the October issue of the ASHRAE JOURNAL.

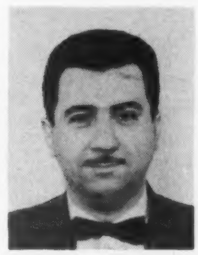
The Chairman, Dan J. Quinn of American Radiator & Standard Sanitary Corporation, presided at all sessions of this 3-day hydronics industry gathering.

ASHRAE NATIONAL MEETINGS AHEAD	1961	1962	1963
	Feb. 13-16 Semiannual Chicago, Ill.	Jan. 28-Feb. 1 Semiannual St. Louis, Mo.	Feb. 11-14 Semiannual New York, N. Y.
	June 26-28 Annual Denver, Colo.	June 25-27 Annual Miami, Fla.	

Heat transfer

from a flat jet of hot air to a curved surface

BORIS KAUFMAN
Associate ASHRAE



S. P. KEZIOS

Abundant information for the determination of coefficients of heat transfer for air flowing over a flat plate is countered by a lack of published data regarding flows of air streams upon curved surfaces. To obtain empirical design data of general interest to design engineers, a project was carried out in the Heat Transfer Laboratory of the Illinois Institute of Technology under the partial sponsorship of the United States Air Force. Here reported, in summary, is the outcome of this investigation.

Determination of heat transfer coefficients from an air stream to a flat plate is expedited by the considerable amount of design data available. There are, however, but limited data to enable establishment of local heat transfer coefficients from an air stream to a curved surface. The Heat Transfer Laboratory of Illinois Institute of Technology, under the sponsorship of the United States Air Force, undertook experimental determination of local coefficients of heat transfer from a flat jet of hot air to a curved plate of fixed curvature. From test data gathered, these coefficients could be calculated and represented in dimensionless form in terms of Nusselt and Reynolds numbers and characteristic lengths.

Description of Test Apparatus — Air, forced by a centrifugal blower over a bank of heating coils and into a mixing chamber, passed through a nozzle of rectangular cross section, over an unheated plane starting section and then contacted a curved plate tangentially and was deflected upward by the curvature of the plate (Fig. 1). Water flowing through a channel cooled the lower surface of the plate. Both curved surfaces were instrumented with thermocouples for measurement of local surface temperatures and the plate was used as a heat flow meter (Fig. 2).

The curved test plate, 1.42 in. thick, had been cast flat of Plexiglas II and a recessed step was cut along the front edge and sides. The plate was then bent to the shape of a segment of a cylinder with a radius of 17.3 in., width of 15 in. and arc length of 28.5 in. on the concave side. There were 39 copper-constantan thermocouples (30 gage) with their hot junctions soldered to small copper buttons, 0.02 in. thick and 0.25 in. diam, and flush-mounted in the upper and lower surfaces of the plate. Lead wires were placed in shallow grooves cut into the surface and brought out through isothermal regions for at least 1.5 in. Figs. 3 and 4 show the locations of the junctions. Grooves were filled with powdered plastics, bonded with acetone. After drying, the plate was sanded and polished.

By placing a galvanized steel sheet 0.25 in. below the curved plate, a water channel was made. Water entered through five tubes at the front end of the channel, flowed upward under the plate and discharged to the drain.

A flat starting section, six in. long, and curved side extensions twelve in. wide, were attached to the front and side recesses, mounted so as to be adjustable in all directions. Cracks between these pieces were filled with plastics to form a continuous, smooth surface.

Velocity and temperature traverses of the air stream were made by means of a rake containing alternate thermocouples and impact tubes at 1.5 in. intervals. The rake slipped into sockets at each of six stations, A to F, along the surface of the plate and was held perpendicular. Rake thermocouples were connected in series and the average was taken as the station temperature. Temperature and velocity data were obtained at eleven different heights, between 0.1 and 2.5 in., at each station.

This photograph, Fig. 1, shows the fully-instrumented curved plate mounted in test position, looking downstream; it shows the thermocouple buttons on the plate surface, the starting section and side extensions (black), the temperature-velocity traversing rake with the adjusting screws and the mounting

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B. Kaufman is Assistant Professor of Mechanical Engineering, University of Idaho, and S. P. Kezios is Professor of Mechanical Engineering at Illinois Institute of Technology.

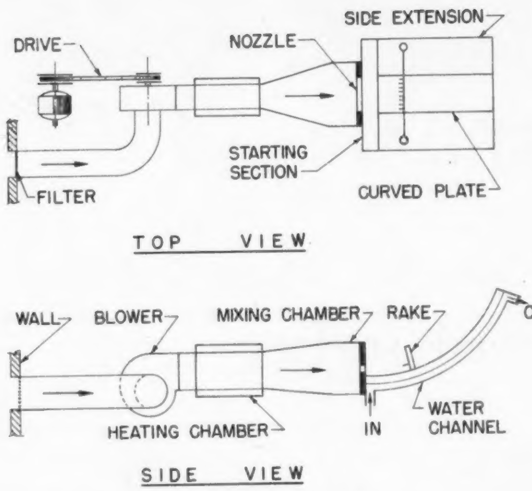


Fig. 1 Schematic diagram of test apparatus

TABLE I
RANGE OF EXPERIMENTS

Item	Symbol	Min	Max	Units
Height of nozzle	a	0.15	0.35	in.
Initial jet velocity	v_o	47.5	232	ft/sec
Initial jet temperature ...	t_o	146	205	F
Flow path/nozzle height ..	x/a	21.4	210	—
Heat flow per unit area ..	q"	506	1283	B/hr-ft²
Local coefficient of heat transfer	h_x	41.3	4150	B/hr-ft²-F
Nusselt number	N_{Nu}	3800	149,100	—
Reynolds number	N_{Re}	125,000	2,575,000	—

sockets for the rake. The nozzle block is at the lower right. Also visible are two of the three thermocouples used to measure environmental air temperature.

The jet nozzle was 17.5 in. wide, and runs were taken at nozzle heights of 0.15, 0.25 and 0.35 in. At all nozzle heights the distance from the bottom of the nozzle to the surface of the starting section was kept at 0.25 in.

Adjustment of initial jet velocity was by means of a variable speed drive connected to the blower. Electric heating coils were used to heat the air to the desired temperature before it entered the mixing chamber. A recording potentiometer kept continuous records of environment and mixing chamber temperatures.

Calibrations — Radius of curvature of the concave surface of the plate was measured while a test was being run, radii of 17.9 and 18.1 in. being found for initial jet temperatures of 150 and 200 F, respectively. An average radius of 18.0 in. was used in calculations of heat flow through the plate.

Thermal conductivity of the plate material at various mean temperatures was determined from two samples of the original plastics sheet. Thermocouples were calibrated by means of a hypsometer at the boiling point of water under atmospheric pressure. The recorder, which measured initial jet and environment temperatures, was calibrated with a portable precision potentiometer.

Test Procedure — Test runs were made only during periods of constant atmospheric pressure and relative humidity. Measurements made in each run included: initial jet temperature, velocity and barometric pressure; temperatures on the upper and lower surfaces of the curved plate; traverses of the jet velocity and temperature above each row of surface thermocouples; and calibration of the recorder. Including the starting period, the time needed for a test run was between three and five hr. Table I gives the range of the experiments and a summary of initial conditions of the test is shown in Table II. The surprisingly high values of h_x are stressed because of the manner in

Fig. 3 Concave surface of curved plate

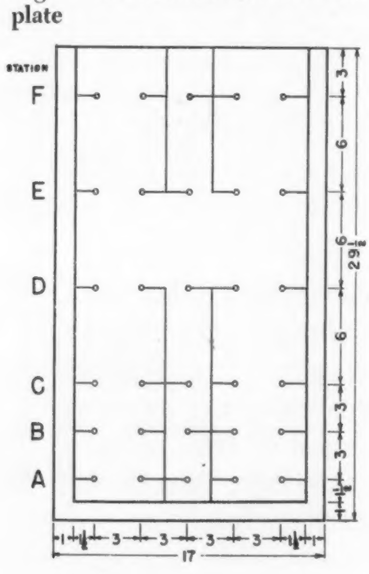


Fig. 4 Convex surface of curved plate

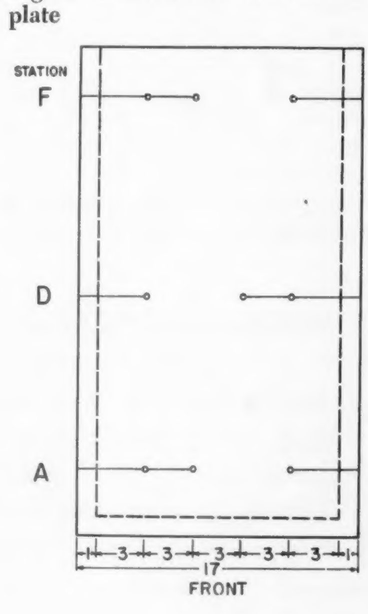


TABLE II
SUMMARY OF EXPERIMENTS WITH CURVED PLATE

Nozzle Height in.	Initial Velocity ft/sec	Initial Jet Temperature F
0.15	63.0	200.0
0.15	90.0	184.1
0.15	139	194.7
0.15	182	193.9
0.15	205	195.6
0.15	231	204.9
0.25	47.8	146.1
0.25	70.8	152.0
0.25	91.0	154.1
0.25	135	149.2
0.25	178	149.0
0.25	221	152.5
0.25	53.3	205.5
0.25	73.5	201.9
0.25	94.2	196.2
0.25	140	198.2
0.25	169	201.4
0.25	231	193.5
0.35	47.5	198.5
0.35	51.0	146.9
0.35	71.3	193.7
0.35	95.5	197.9
0.35	142	192.9
0.35	186	196.4
0.35	232	194.2

which this local coefficient is defined (see under Experimental Results).

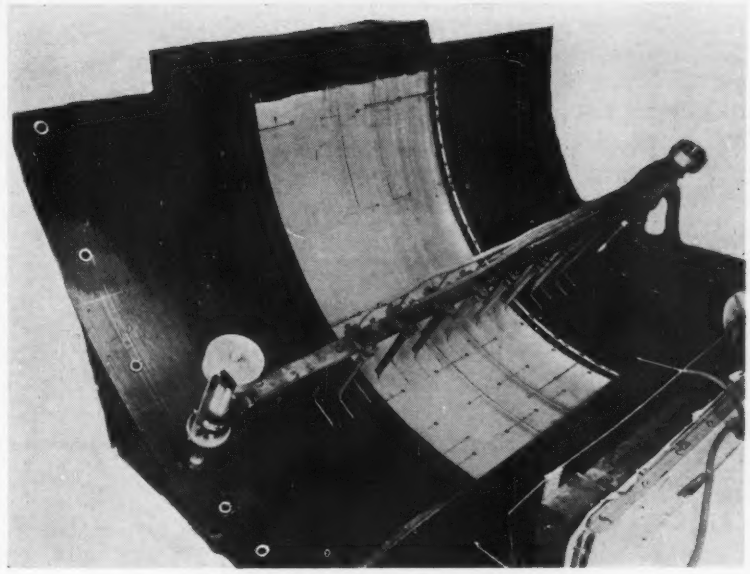


Fig. 2 Curved plate and rake

Experimental Results – Two assumptions upon which the calculations were based are that the jet velocity and temperature at any distance from the plate are practically constant over the width of the test surface, and that the length of the path of heat flow through the plate is equal to the thickness of the plate. Required by the first assumption is that surface temperature and velocity distribution across the width of the concave surface be practically constant. Accordingly, surface temperature and velocity distribution for a characteristic run were plotted and justification for this assumption was established.

The second assumption was checked by determining temperature distribution within the plate. A full-scale drawing of a longitudinal cross-section of the plate was made, and local surface temperatures were marked. Isothermal lines were drawn, and it was apparent that the gradient of surface temperature in the flow direction had a negligible effect upon the pattern of radial heat flow.

In order to determine any difference in the value of the surface coefficient of heat transfer if the temperature between the jet and the plate varied, six runs were made with an initial jet temperature of approximately 150 F and six with an inital jet temperature of approximately 200 F. Nozzle height was 0.25 in. and the initial jet velocity range covered was approximately the same (Table II). The surface coefficient of heat transfer was found to be independent of the temperature difference.

Typical velocity and temperature traverses are given in Figs. 5 and 6, respectively. From these curves max jet temperatures and velocities were established. Jet velocity decay v_x/v_o was determined by a logarithmic plot of this ratio against x/a (Fig. 7), which led to the empirical equation:

$$v_x = 2.37\, v_o\, (x/a)^{-0.33}$$

valid in the range x/a = 21.4 to 210.

This relationship shows the jet to maintain a max velocity of V_o for approximately 10 slot widths downstream of the nozzle exit; this is approximately 5 times the equivalent diam of the issuing jet, which is itself 2 times the nozzle height or 2a. This initial decay length corresponds to that found for an axisymmetric free jet.

It is of interest to note that the jet decay of axially symmetric flows[1] shows:

$$v_x \sim v_o\, (x/a)^{-0.50}$$

A similar method was used to determine the jet temperature decay relationship. The correlation between the temperature-decay ratio, $(t_o - t_x)/(t_o - t_e)$ and x/a, was found to be:

$$(t_o - t_x)/(t_o - t_e) = 0.715 - 0.55\, e^{-0.013\,(x/a)}$$

which is valid in the range from x/a = 21.4 to 210.

In order to determine the Nusselt number it was first necessary to find the heat flow through the plate. To determine heat flow through a unit area of the curved plate, the equation used is:

$$q'' = \frac{k_m\ (t_s - t_b)}{r_b\ \ln\ (r_a/r_b)}$$

Heat flow through the plate must be the same as heat flow from the jet to the surface of the plate:

[1] See, for instance Momentum and Mass Transfer in Coaxial Gas Jets, W. Forstall and A. H. Shapiro (Journal of Applied Mechanics, December 1950). This paper includes an outstanding summary of jet literature up to that time.

Fig. 5 Typical jet velocity profiles

Conditions for tests producing Figs. 5 and 6 a = 0.25 in.; V_o = 178 ft/sec t_o = 149.0 F; $+_e$ = 83.7 F; t_b = 34.7 F

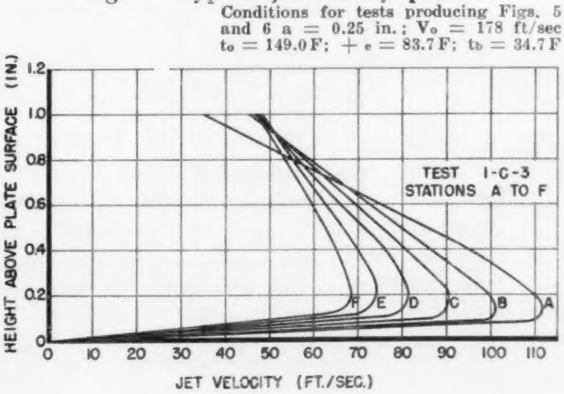
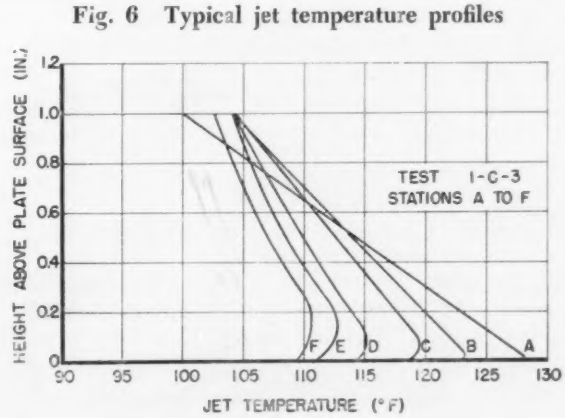


Fig. 6 Typical jet temperature profiles



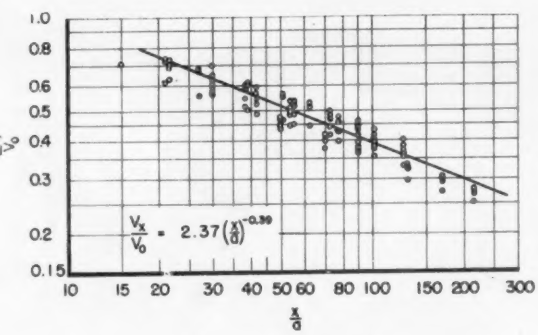


Fig. 7 Velocity decay curve

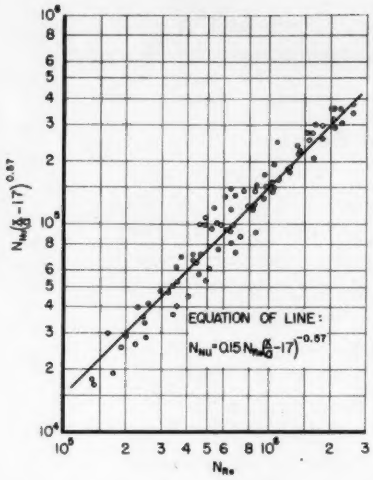


Fig. 8 $N_{Nu}\left(\frac{x}{a} - 17\right)^{0.57}$ **vs** N_{Re}

$$q'' = h_x\ (t_x - t_s)$$

Equating these two values of q″ leads to the equation for the surface coefficient of heat transfer:

$$h_x = \frac{k_m\ (t_s - t_b)}{(t_x - t_s)\ r_b \ln (r_s/r_b)}$$

From this value of h_x the Nusselt number can be determined as

$$N_{Nu} = \frac{h_x\, x}{k_f}$$

In seeking a dimensionless correlation of the Nusselt number versus a characteristic Reynolds number, two different definitions of the Reynolds number were tried:

$$(N_{Re})_o = \frac{v_o\, x}{\gamma_o}$$

$$(N_{Re})_x = \frac{v_x\, x}{\gamma_x}$$

NOMENCLATURE

Symbol	Quantity	Unit
a	Height of nozzle	ft
C, C_1, C_2	Constant	—
h_x	Local coefficient of heat transfer from the curved plate to the air jet	Btu hr^{-1} ft^{-2} F^{-1}
k_f	Conductivity of air at the film temperature, t_f	Btu hr^{-1} ft^{-1} F^{-1}
k_m	Conductivity of the plate at the mean plate temperature, t_m	Btu hr^{-1} ft^{-1} F^{-1}
q″	Heat flow through a unit area	Btu hr^{-1} ft^{-2}
r_b	Radius of convex surface of plate	ft
r_s	Radius of concave surface of plate	ft
t_b	Temperature of convex surface of plate	F
t_e	Temperature of environment	F
$t_f = \frac{1}{2}(t_x + t_s)$	Temperature of air film	F
$t_m = \frac{1}{2}(t_b + t_s)$	Mean plate temperature	F
t_o	Temperature of air at exit of nozzle	F
t_s	Temperature of the concave surface of the plate	F
t_x	Maximum temperature of the air jet at the distance x	F
v_o	Velocity of the air at the exit of the nozzle	ft sec^{-1}
v_x	Maximum velocity of the air jet at the distance x	ft sec^{-1}
x	Surface distance from the nozzle	ft
γ_o	Kinematic viscosity of the air at the temperature t_o	ft^2 hr^{-1}
γ_x	Kinematic viscosity of ν air at ν temperature t_x	ft^2 hr^{-1}
$N_{Nu} = \frac{h_x\, x}{k_f}$	Nusselt number	—
$N_{Re} = \frac{v\, x}{\gamma}$	Reynolds number	—

The Nusselt number was plotted against the Reynolds number for each slot opening, with the value of x/a used as the parameter. Two sets of curves were made, one with the Reynolds number based on properties of the air at the exit of the nozzle, and the other with the Reynolds number based on local properties of the jet. Straight lines were drawn to represent these values of x/a and a cross-plot was made of the value of the Nusselt number at a Reynolds number of 10^6 versus x/a. This was done for both definitions of the Reynolds number. It was found that the value of the Reynolds number based on the properties of the jet at the nozzle would more readily correlate the data, and this definition of the Reynolds number was used.

From preliminary examinations it was found that the Nusselt number was nearly proportional to the Reynolds number. A correlation of the form:

$$N_{Nu} = C_1\ (N_{Re})\ C_2\ (x/a)$$

was assumed. The ratio of the Nusselt number divided by the Reynolds number was plotted against x/a and a curve was drawn through these points using the method of

[1] Defrosting and Ice Prevention, M. Jakob, et al., (Final Report to Wright Patterson Air Force Base, Contract W33-0.38 ac-16808, April 28, 1950, p. 68-71).

gravitational centers. This could be represented by either

$$N_{Nu} \left[(x/a) - 17 \right]^{0.57} = 0.15\ N_{Re}$$

or,

$$h_x = 0.15\ (k/x)\ \left(\frac{V_o\, x}{\gamma_o}\right) \left[(x/a) - 17 \right]^{-0.57}$$

valid in the range $x/a = 21.4$ to 210. (Fig. 8)

Included in this equation is radiation from the plate to the environment in a direction opposite to that of the convective heat flow. In an unpublished report to Wright Patterson Air Force Base,[1] it is shown that multiplying the right side of these equations with a factor of 1.045 yields the heat transfer by convection alone in close approximation for the temperature range of the experiment.

CONCLUSIONS

A dimensionless correlation for heat transfer from a flat jet of hot air to a curved surface of 18-in. radius has been obtained. Shown by the correlation is that the Nusselt number is proportional to the first power of the Reynolds number, based on the initial properties of the jet. It is known that the same high exponent (1.0) of the Reynolds number occurs in fully developed turbulence over rough surfaces and it appears that in the present case this exponent is the result of the action of centrifugal forces and the diffusing flow pattern.

(*Continued on page* 95)

Ice removal

presents its problems, too

R. S. TAYLOR
Member ASHRAE

Sometimes ice can be a most unwanted thing. There are basically three methods by which it may be eliminated. Here is an informal review of some points of difficulty and of those ways by which ice may be removed.

That ice upon refrigerating coils is undesirable is too well established to deserve special comment, but how often do we consider other points where resourcefulness, skill and know-how are required to solve an ice removal problem?

Ice and snow interfere with the planned operations of transportation, communications, and power systems. They disrupt radar and radio communications both by mechanical breakage and by shielding the antenna. When an airplane flies into clouds or visible moisture particles supercooled below 32F, icing quickly occurs; going to a different altitude, or use of some form of deicing equipment is usually necessary. Ice forming in certain areas of the carburetor and air intakes causes power decrease and often engine failure; prevention or removal becomes vital. Considerable study has been and is continually being carried out on the precluding of ice deposition and on its removal in all of these areas.

Basically, all methods of ice removal fall in one or more of three categories. 1. Mechanical, 2. Chemical, 3. Heat Operated.

1. Mechanical Methods;

1.1 For the removal of "Pond Ice" the mechanical sawing out of blocks was and is still standard.

1.2 Snow plows and shovels are mechanical means used where moving or removal of large masses of snow is necessary.

1.3 Water increases in volume when it freezes. Hence, pressure can depress the freezing point or cause ice to melt. The weight of glaciers causes sufficient pressure to melt a film of water under them and thus permit their movement. The expansion of water in freezing also can be and is sometimes used to produce the mechanical force to release the ice from surfaces.

1.4 Ice adherence varies with different materials. Those materials most easily wetted by water will have the greatest adherence to ice and vice versa. The force required to separate ice from a solid material depends on the area of the exposed surface as well as the adherence. A lessening of the force required is accomplished by reducing the surface being broken loose at any one time. Step-wise breakage or peeling loose thus reduces this force.

Rubber grids and rubber trays were the earliest of the quick release trays for household refrigerators because stretch of the rubber automatically gives a peeling action to the process of removal. Because of the low heat conductivity of the rubber, freezing times with these trays and grids were excessively long. Also, in continued use, adherence between rubber and ice increases so that it becomes more and more difficult to break the ice loose. Apparently this is due to the surface gradually becoming more hydrophilic (water loving). These problems have caused a decrease in the use of rubber for the mechanical release of ice.

The aircraft industry still uses "Rubber Boots" for ice removal on some aircraft. Here the peeling action is obtained by inflating and deflating the boots. These boots

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have a relatively short life especially on exposure to ultraviolet light and heat. Frequently the rubber surfaces are treated with a waxy material to lessen adhesion of the ice. The treatment generally needs periodic reapplication.

Waxing is a method which lessens the "wetability" and consequent adhesion of ice to surfaces. It is necessary to wax anodized aluminum ice trays and grids for the lever-action quick release grids to function. The preferred wax is a high melting point amorphous type which lasts longer in service than crystaline and lower melting waxes. Vegetable, petroleum, and silicone base waxes have all been used as have combinations of these.

Several wax preparations are marketed for aircraft boots. These have the same requirements as those used for ice trays and grids except that odor and taste are not important. The useful life of any wax application is limited because of mechanical erosion from impinging moisture on the treated surfaces.

Even now, plows and snow shovels work better if greased or waxed so that the snow will release more freely.

Plastics which have a low coefficient of adhesion with ice, especially when newly molded, are used for grids and trays in some refrigerators. Some automatic ice-makers have been coated, simularly to lessen adhesion and permit mechanical release of the ice. The coefficient of adhesion seems to increase in service for these materials so even they must in time be replaced or coated with wax.

Moisture particles in an air stream are heavier than the air. Hence if the air stream direction is changed sharply, the particles will overshoot the air. This fact has been used to mechanically separate the air from supercooled moisture particles. In this way ice formed can be made to deposit outside an air intake, while the air enters an opening thus kept free of ice.

Still another mechanical method is no more complicated than scraping with a sharp blade. This is the method used to remove ice frozen on smooth drums to produce small-particle or flake ice.

2. Chemical Methods.

2.1 Rock salt and calcium chloride are both used to melt ice and snow. The resulting solutions are corrosive. The salts are also expended. These treatments are then only useful where 'one shot' applications are sufficient.

2.2 For airplanes it is often necessary to remove past accumulations of frost, snow or ice prior to take-off. These are 'one shot' applications. Here non-corrosive materials like iso-propyl alcohol and glycol-alcohol mixtures are used.

The DeHaviland Dove airplane has a wing deicing system where such a solution exudes through a porous member located on the leading edge at the point of maximum ice impingement.

Propeller deicing is often accomplished by feeding iso-propyl alcohol or other non-corrosive mixtures to the leading edge of the propeller near the hub. This is done with a slinger ring which collects the alcohol from a stationary feed and dispenses it to the propeller. Centrifugal force distributes the material along the length of the propeller.

2.3 Carburetor ice is a form of ice which causes problems for both automobile and aircraft engines. The evaporation of gasoline in the carburetor produces refrigeration. Under certain humidity and temperature conditions this will give freezing temperatures and produce ice in the carburetor. Chemical treatment of the gasoline to prevent this has been used especially with automobile gasolines.

The treatment used is an additive (aliphatic diamine) to the gasoline which will cause the surface in the carburetor to preferentially wet with the additive and the gasoline. When the surfaces are thus wetted, the ice formed will not stick, but will pass on into the engine. These same organophilic (oil-loving) or hydrophobic (water-hating) fluids could be used in propeller deicing with benefit.

3. Heat Operated — Heat is accepted as the most effective and closest to foolproof method of ice removal. Ice will not stick to any surface which is above 32 F, and, of course, will not exist in an ambient above that temperature.

The 1960 ASHRAE GUIDE says:—"The practicability of melting snow by means of heated coils has been demonstrated in a large number of installations in sidewalks, roadways, ramps and runways."

Can ice is removed by warming the cans above the melting point of ice. Although quick release ice trays are now quite common in household refrigerators, they become more difficult to operate as the wax wears off. In due time the ice is removed from most of these by the old reliable method of warming the ice tray under water from the tap.

The majority of the automatic ice-makers, whether for commercial use or for household refrigerators, use heat as the most reliable procedure for removal of the cubes, circles or chunks of ice produced.

Defrosting of refrigerators, once a matter of turning off the gas or electricity, opening the door, blowing hot air into the evaporator with a fan, melting the ice with hot water and so on has yielded to heating the same surface that produces the refrigeration. The heat can come from hot gas or vapors, or the surface may have electric heating elements suitably placed. These are the methods used in modern defrosting techniques. Even the so-called no-frost refrigerators get their essential characteristics by causing the frost to deposit on hidden coils and then automatically defrosting the coils as needed by using heat.

Present processes of ice removal from airplanes also rely on heat. Here the use of electrical energy is not as general as in refrigerator defrosting because of the penalties in weight and the power requirements. Efforts to reduce these penalties by step-wise application of the electric heat have not given sufficient improvement to cause much acceptance of electricity for this purpose.

Thus the use of electricity for aircraft deicing is usually limited to small applications not requireing large amounts of heat and difficult to heat otherwise. For example pitot tubes are almost universally heated electrically.

Aircraft windshields are sometimes heated electrically; sometimes with hot air.

(*Continued on page* 89)

. . .what makes up our Committee organization

ARTHUR J. HESS
Presidential Member
ASHRAE

The most important component in the operating mechanism of our Society is the committee structure, for it is through a committee operation that most of the plans of operation are made and implemented and on which many Society functions are carried out. It, therefore, came somewhat as a shock to me when I found at Regional and Chapter meetings a woeful lack of understanding of just what makes up our committee organization, how these committees function, and how individuals can participate. Because these committees are the life blood of our Society, it is desirable to clarify their function to the members, especially those who might be able and desire to serve on a national committee.

There is an excess of 25 main committees with over 300 members in the Society structure, with many of these committees having sub-committees and task committees. These main committees can be divided into two major classifications: Technical committees and the committees that perform non-technical functions to operate the Society.

Technical committees plan and oversee the various technical functions of ASHRAE, truly important in a technical society. The Research and Technical Committee is probably the most important in this category. This committee has a large group of sub-committees which perform specific tasks in our Research Program.

The Research and Technical Committee oversees these committees and also operates the business of Society research, a quarter of a million dollar a year program. Two other important technical committees with somewhat similar functions are Program and Publications. Annual and Semiannual programs are planned and implemented by the Program Committee which often is working over a year ahead. The Publications Committee has charge of all publications of the Society, including both the business of publication and the technical quality of the publications.

Another major committee is the Standards Committee which has charge of Society standards, joint standards with other Societies and the promulgation of new standards. This committee has a group of task committees to work on specific standards. Please refer to the November issue of your JOURNAL, pages 84 and 85, to see the surprising extent of these sub-committees. We can be proud of our record in "Standards."

Non-technical committees are many and handle those specific functions of the Society. Some of these committees are devoted to membership relations such as Admissions and Advancement, Regions Central, Education and others. Other committees have to do with Society relationships with other groups and Societies such as AIA-ASHRAE Joint Committee and many other joint committees.

There are committees set up to handle Society problems, as example, Long Range Planning, Charter and By-Laws and Awards. There are three very important non-technical committees that also should be mentioned: 1. Executive Committee made up of officers and some past Presidents that fill in for the Board of Directors between meetings; 2. Nominating Committee (probably the most important single committee in the Society), this committee makes the nominations for officers and the Board assisted in part by suggestion from the Chapters Regional Committees; 3. The Finance Committee that has charge of the business administration.

Technically speaking, in all but a few committees, the members are appointed each year which to say the least could cause much confusion and dead center operation if followed to the letter. However, by agreement of the Directors, many committees are set up for three year continuity, thus eliminating as much of the confusion as possible.

There are several ways in which the membership of committees are made up. General and special committees are appointed by the President with approval of the Board of Directors. This is a man-killing operation for our President and we should cooperate to the fullest with him whenever possible. Technical Committees and Research Panels are appointed by the Chairman of the Research and Technical Committee.

Working committees on the GUIDE AND DATA BOOK are appointed by the Chairman of the Guide and Data Book Committee.

The Chairman of the Standards Committee appoints the Standards Project Committee.

Research and Technical Committee is elected by the Board of Directors who welcome any suggestions any member cares to make. The Nominating Committee and Executive Committee are set up by the By-laws. We try to avoid the type of committee described by a famous American who said, "a Giraffe is an animal that must have been designed by a committee."

Our Society is now a large Society which requires much more work by the committes thus requiring more membership participation in order to get the work of ASHRAE done. This new life blood should come from diversified areas of interest in the industry as well as from wide spread geographical considerations. This is also our main source of future officer material. There must

(*Continued on page* 95)

Comparison of the accuracy of

Humidity measuring i

Importance of humidity control to various processing industries, as well as to comfort air conditioning, has stimulated investigation of the relative accuracy of humidity measuring instruments. Tests conducted on instruments in common usage, as herein outlined, indicate that reliable readings of relative humidity are given by a sling psychrometer or an air-aspirated hygrometer with intermittent wet bulb wetting and a hygroscopic coated sensing element. However, hair and diaphragm-type instruments do not respond to sudden humidity changes; and the reservoir-fed wet bulb wick is not at all reliable in the findings of the author.

Control of humidity has become vital to successful operation of many industries. Textiles, tobacco, food processing and comfort air conditioning are but a few of the industries that must control moisture content in the atmosphere surrounding manufacturing processes, or, in the case of comfort air conditioning, the air in office buildings, factories, residences and public meeting places.

Since humidity control is important, and in as much as humidity control cannot be any more exact than humidity measurement, it is necessary to be able to determine the moisture content in a given atmosphere to a high degree of accuracy. There are in common use today numerous instruments which can be used in work upon either absolute or relative humidity of a specific air sample. In order to establish the relative accuracy of a selected few of these instruments, a series of tests was performed in the mechanical engineering laboratories of the University of Florida under controlled conditions, and the results of these tests were used as a basis for plotting a series of curves. By comparing the curves for each of the instruments, it was possible to compare the accuracy of the instruments.

Tests were performed on

a sling psychrometer

hair-type relative humidity recorder

organic diaphragm-type relative humidity indicator

a **stationery wet and dry bulb thermometer** located in the inlet air stream of a blower with the wet bulb wick extending into a reservoir of distilled water

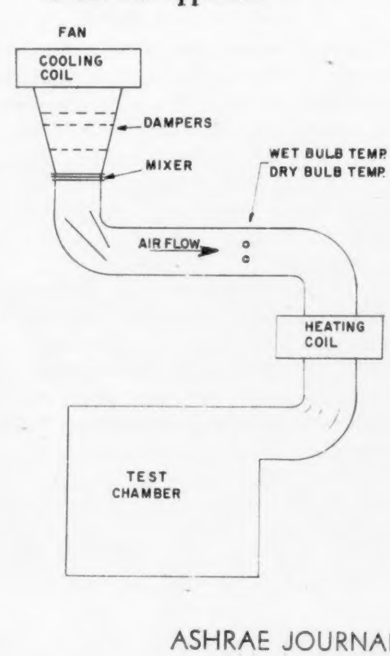
the same type as the preceding, except that thermocouples were substituted for thermometers

a **sensing element** coated with a hygroscopic material, this material being of a type that changed its electrical properties with regard to electrical resistance as humidity changes occurred in the air surrounding the sensing element

wet and dry bulb thermometers located in the intake stream to a blower with the sensing bulbs of both thermometers shielded from radiation by means of a plastics cover. The wet bulb wick was moistened with distilled water prior to each humidity measurement but no moisture was added to the wick during a given test.

Shown in a schematic sketch in Fig. 1A is the test chamber used for testing the hygrometers. Tests were performed with the equipment operating as follows: Steam of 100% quality was admitted to the air on the upstream side of the fan in sufficient quantities to bring

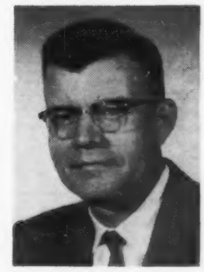
Fig. 1A Schematic diagram of the test apparatus



F. M. Flanigan is Associate Professor of Mechanical Engineering at the University of Florida. Material covered in this paper is based on data collected by Michel C. Khodr as partial fulfillment for a degree of Master of Science in Engineering, under the supervision of the author.

instruments

F. M. FLANIGAN
Member ASHRAE



air entering the cooling coil to a saturated condition. As the air passed through the cooling coil, moisture was removed, air temperature was reduced and air leaving the coil was assumed to be at saturated condition.

The duct carrying air away from the coil was insulated with four-in. of glass wool, and wet and dry bulb thermometers were located at a point downstream from the coil; the wet bulb wick was moistened intermittently. Location of the thermometers was such that they were protected from radiation effects. When the wet and dry bulb temperatures at the point described previously were the same, it was assumed that air at this point was saturated completely. A reheat coil was installed downstream from the thermometers, and again precautions were taken against radiation effects to the wet and dry bulb thermometers. Sensible heat was added to the air stream by a reheat coil, thereby bringing about a change in relative humidity, but not affecting absolute humidity.

Care was taken to insure uniform air flow throughout the test chamber and air was exhausted from the chamber in such a manner as to aid uniform air distribution. National Bureau of Standards calibrated thermometers were used for the measurements of wet and dry bulb temperature. Air flowing through the equipment from the time it entered the cooling coil until it left the test chamber was under a positive pressure to insure that room air did not infiltrate the air sample going to the chamber.

With the equipment operating as described previously, it was possible to establish the absolute humidity of the air sample entering the test chamber and, by measuring the dry bulb temperature in the test chamber, the relative humidity within the test chamber could be predicted by means of a psychrometric chart.

By varying the sensible heat added to the air sample at the reheat coil, it was possible to vary the relative humidity within the test chamber. For a given test the equipment was brought to equilibrium, hygrometers were placed in the test chamber, readings were taken and compared to the relative humidity predicted by means of the psychrometric chart.

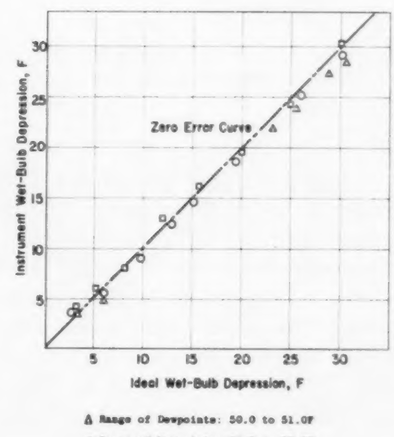
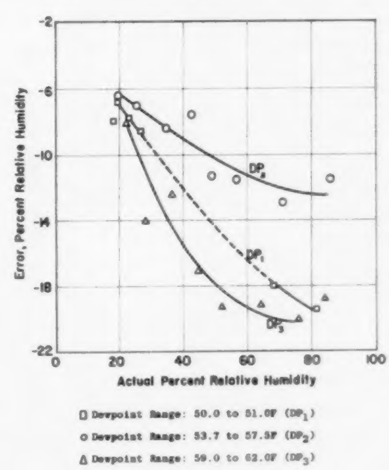


Fig. 2 Wet bulb depression error of sling psychrometer

Fig. 3 Error curves for hair-type humidity recorder



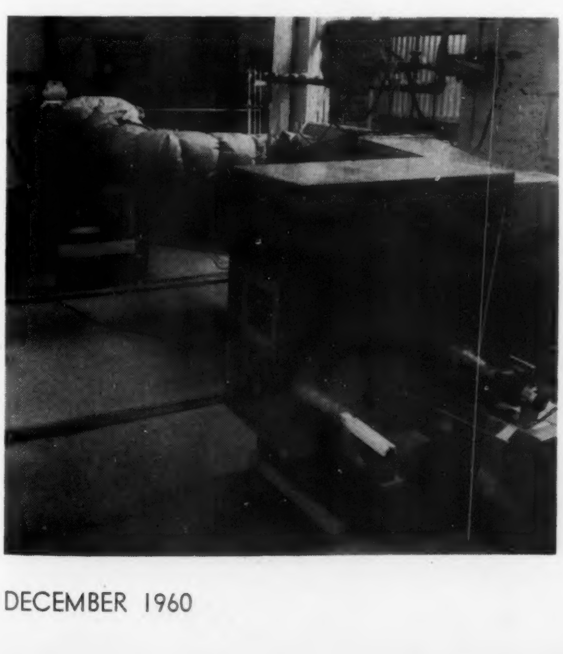


Fig. 1B General equipment layout

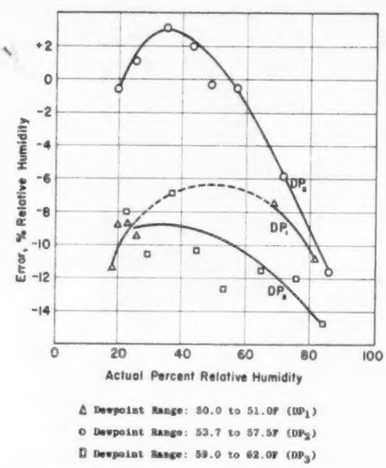


Fig. 4 Error curves for diaphragm-type hygrometer

Fig. 2 is a plot of data obtained using a sling psychrometer and covers a range of dewpoint temperatures from 50 to 62 F. Also shown is a zero error curve indicating the wet bulb depression which should have been obtained with a sling psychrometer. Thermometers in the sling psychrometer used in this test were calibrated against National Board of Standards thermometers and the sling psychrometer rotated within the test chamber at a speed sufficient to cause air to pass the wet bulb wick at a velocity of 900 fpm. Data obtained with the sling psychrometer did not fall in all cases on the zero error curve. This would show that an error was being introduced due to radiation, either from or to the sensing bulbs of the thermometers in the sling psychrometers.

Fig. 3 shows a plot of data obtained using a hair-type humidity recorder. In this case, the actual humidity is used as the abscissa and the error present in the hair hygrometer as the ordinate. At no time did the hair hygrometer give a reading that was absolutely correct; at times the error was as much as 20% relative humidity. In general, instruments of this type are calibrated for rather limited ranges of humidity variation, usually on the order of 20% R.H., and are not expected to be accurate outside this range. The same is true of the instrument used to obtain the data plotted in Fig. 4.

Fig. 4 is a plot of actual relative humidity against percent error in relative humidity; these data being obtained with a diaphragm hygrometer. This instrument had a wide variation in its readings but indicated a greater reliability than the hair hygrometer, specifically in the dewpoint range from 53 to 57 F and in the 20 to 60% R.H. range. Both the diaphragm and hair-types seemed to be sensitive to absolute as well as relative humidity.

There is reason to believe that hair and diaphragm hygrometers will, under actual operating conditions, give more accurate results than those obtained by the tests described. The author has continued to run a series of tests on these two instruments, keeping them in an air conditioned office and running checks on the relative humidity indicators of both. Using as a check instrument the shielded bulb, air aspirating, intermittent wet bulb moistening-type of hygrometer, he has found that if the hair and diaphragm hygrometers are calibrated properly and placed in an atmosphere where humidity variation is not excessive, the reading can be relied on with but limited error. Tests conducted in the air conditioned office space have shown a maximum error of not more than 5% less than the actual R.H.

Shown in Fig. 5 are results obtained using stationary wet and dry bulb thermometers immersed in an air stream on the suction side of a blower; the wet bulb wick extended into a reservoir of distilled water (Fig. 6). Instrument wet bulb depression was smaller in almost all cases than ideal wet bulb depression, indicating that the instrument was not achieving a true wet bulb temperature.

A study of this instrument revealed that the probable source of error in this case was related to the wick and its connection to the water reservoir. Water in the reservoir was at or near ambient dry bulb temperature and would, therefore, be greater than the ideal wet bulb temperature. Thus, the wick extending from the wet bulb thermometer to the water in the reservoir furnished a means of transferring heat from the water to the thermometer sensing element, and

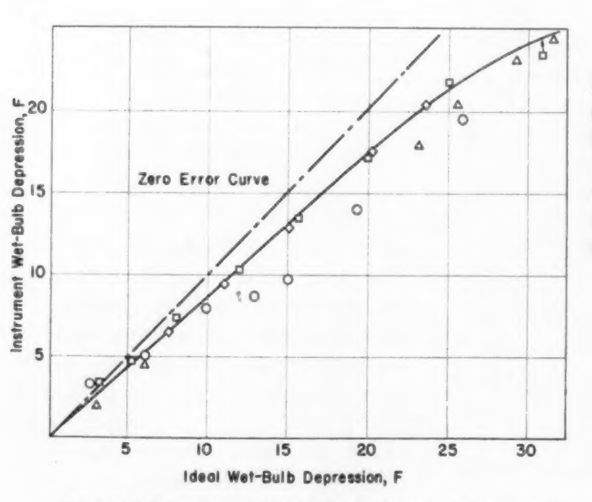


Fig. 5 Wet bulb depression error for air aspirating psychrometer with wet bulb wick in reservoir of water

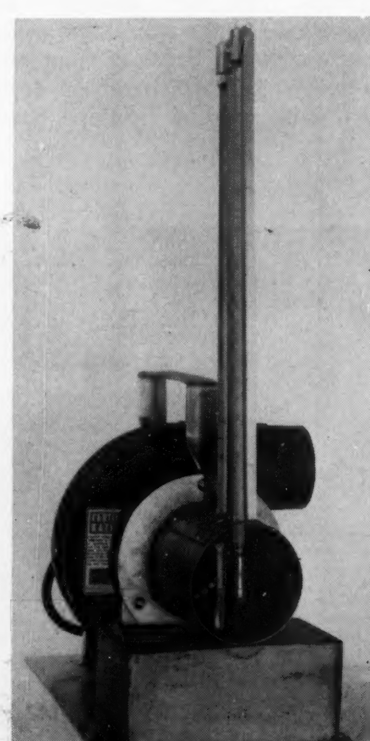


Fig. 6 Air aspirating psychrometer

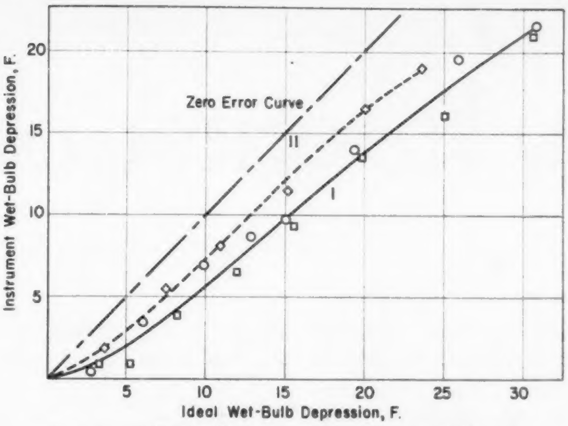


Fig. 7 Wet bulb depression error of thermocouple psychrometer. Curve I: wick moistening by capillary action. Curve II: intermittent moistening of wick

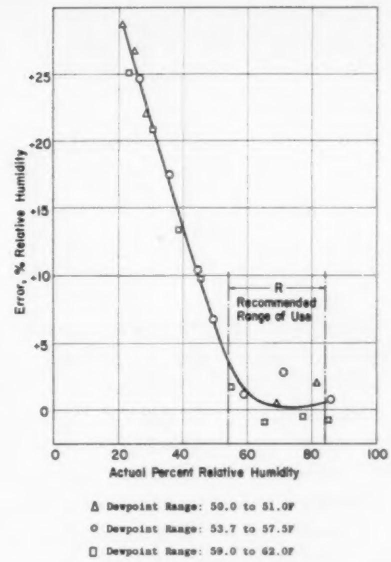


Fig. 8 Error curves for instrument with a coated sensing element of hygroscopic material (electrical resistance change with humidity change)

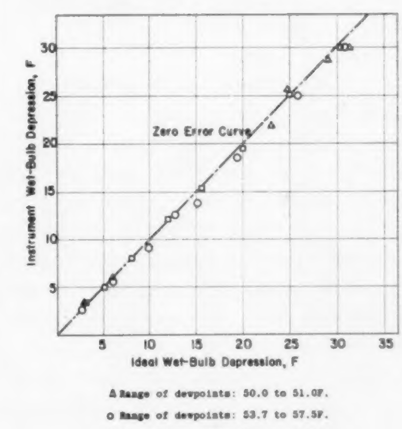
thereby increased the indicated wet bulb temperature.

Data plotted in Fig. 7 were obtained with an instrument similar to the one used to obtain data for Fig. 5, except that thermocouples were substituted for the wet and dry bulb thermometers. Results obtained with this arrangement were erratic and extreme care had to be taken when the wick was placed on the wet bulb thermocouple. If the wick did not come into complete contact with the thermocouple junction, errors were introduced, and even when the wick was subjected to intermittent wetting and not connected to the reservoir, errors persisted. This can probably be attributed to a minor misplacement of the wet bulb wick.

Fig. 8 presents results obtained using a sensing element coated with a hygroscopic material. The instrument was of commercial manufacture and, as long as it was used within the manufacturer's recommended range, excellent results were obtained.

Results in Fig. 9 were derived

Fig. 9 Wet bulb depression error for air aspirating psychrometer with radiation shielding and intermittent moistening of wick



using stationary wet and dry bulb thermometers, protected and shielded from radiation effects and located on the intake side of a blower. The wet bulb wick was moistened prior to each test. Results obtained with this instrument suggest a high degree of accuracy.

Results of the test program as outlined in this article reveal that of the instruments tested, the sling psychrometer, the air aspirated hygrometer with intermittent wet bulb wetting and the hygroscopic coated sensing element are instruments which will give reliable readings of relative humidity. Furthermore, the tests indicate that the hair and diaphragm-type instruments do not respond to sudden humidity changes and require a considerable amount of time to stabilize. Probably the most important conclusion is that the reservoir-fed wet bulb wick is not a reliable instrument, and has, in fact, a built-in error factor which cannot be corrected readily. This is important since, to the author's knowledge, this type of hygrometer is in wide spread use and undoubtedly has contributed a vast amount of inaccurate information.

At the International

A. T. BOGGS, III
ASHRAE Technical Secretary

In our November JOURNAL there was a preliminary report on meetings to be held in Paris and having to do with international standardization. The writer was a member and secretary of the U. S. delegation that attended those sessions. This is a report on conclusions reached during the meetings and of the part played by U. S. industry through its standardization programs.

Perhaps a resume of the meetings attended would help to establish the background of results attained at these meetings. International standardization is not new to the U. S. For a number of years the U. S. has participated in such activities as a member of the International Organization of Standardization (ISO). The U. S. activities in this work are directed by ASA, but the viewpoints of U. S. industry are developed by industry advisory committees.

Each area of interest is covered in ISO by a technical committee established for the purpose. Any country interested may be a participating or observer member. The ISO technical committee on which this report is based covers the general fields of refrigeration and air conditioning, and is called ISO/TC 86 – Refrigeration.

The subcommittees of this technical committee cover: Safety; Terminology, Definitions and Symbols; Testing of Refrigerating Systems; Testing of Refrigerant Compressors; Construction and Testing of Household Refrigerators; Testing of Factory-Assembled Air-Conditioning Units; and a special task force working on the development of an international system of numbering refrigerants. These subjects are of particular interest to a large segment of ASHRAE.

Before discussing specific subjects, there are general items that may be of interest. First, these subcommittees were really international – delegates present represented Belgium, Czechoslovakia, Denmark, France, Germany, Great Britain, Holland, India, Italy, Russia, and the U. S., as well as other international bodies allied with ISO or the general field of refrigeration.

The U. S. delegation was composed of F. J. Reed, Chief Engineer, Air-Conditioning & Refrigeration Institute, and the writer for Subcommittees 3, 4, 5, and 6, and Dr. D. E. Kvalnes, Manager–Technical, duPont, and the writer for Working Group 1.

It is educational, enlightening, and a real thrill to sit at a conference table with representatives from other countries and realize that a common understanding concerning certain subjects is being attained for the benefit of all, particularly many of the newer countries that have not yet established their own standards system.

In this particular field it should be stated that in every committee all delegates looked to the U. S. for basic information included in its industry standards. All delegations recognized that the U. S. had progressed further in the refrigeration field – compressors, refrigerators, and particularly air conditioning equipment – than any other country. Since we are leaders in this field, it is of importance that we give leadership to the development of international recommendations in the field. These recommendations will benefit all segments of industry since they are intended to be guideposts for international trade. If we are not active participants in such work, it could become a reality that products of our country might not be applicable in foreign trade areas. Since most countries already use U. S. standards as bases for the development of their own national standards, it is highly important that our participation in international work serve to avoid misinterpretation of our standards or misapplication of such data.

The principal barrier to progress and mutual understanding in international standards work is communication. It was evident at these meetings that the delegations generally desired the same type of engineering information in any proposed recommendations, but it was difficult to get an accurate interpretation from one language to another. The magnitude of this problem is evident when it is realized that all meetings were conducted in two, sometimes three, languages, and that the proposed recommendations will be published in as many as five languages.

In some instances we found there was no straightforward translation from one language to another. The most important area of our efforts was related to this idea of communication between national groups, between individuals, and most important, between national philosophies. The U. S. delegates feel that we made tremendous headway in all aspects of this work, particularly in the area of interpreting our industrial system and standardization procedures.

Four of the subcommittees and the Working Group on Refrigerant Numbering held meetings in Paris. The U. S. is secretariat for the working group and Subcommittee 6 which is concerned with factory-assembled air conditioning units. Consequently, for the working group Dr. Kvalnes served as chairman and the writer as secretary, while for Subcommittee 6 Mr. Reed served as chairman and the writer as secretary. Because of our particular interest in these two

A. T. Boggs, III, F. J. Reed and D. E. Kvalnes were accredited members of the U. S. delegation at the Paris Meeting of the International Organization of Standardization, in October.

Standardization Meeting

committees, this report will consider first the progress made by these groups.

Working Group 1 is concerned with the development of an international system of designating refrigerants. The U. S. as secretariat proposed for consideration the ASHRAE Standard 34-57 – Designation of Refrigerants. This standard was approved as an American Standard-B79 on September 14, 1960. Since the basic numbering system included in this standard has already been used in many countries, it was proposed as the basis for an international system.

The members of the working group agreed to use the American Standard as a basis. It was decided, however, that the numbering system would be used only for the following groups of refrigerants: Halocarbon compounds, cyclic organic compounds, azeotropes, hydrocarbons, and unsaturated organic compounds. It is proposed that all other compounds used as refrigerants be designated by chemical name or formula. Because it is possible to have unlimited mixtures of basic refrigerants, it was agreed that there should be no numbering system applied to mixtures except for the azeotropic mixtures. Mixtures other than azeotropic will be designated by reference to their qualitative and quantitative composition.

Although the basic American document indicates that no abbreviation of the word "Refrigerant" is to be used, it was decided that for international work the capital letter "R" should be considered. For example, Refrigerant 12 would be indicated as R 12. This system of using the letter "R" for the abbreviation of the word "Refrigerant" is already in general use and it was agreed that the use of such an abbreviation would not cause any difficulty in trade designation.

Subcommittee 6 is concerned with factory-assembled air conditioning equipment. It was decided that although the scope of activities of the committee would cover all factory assembled equipment, the first effort would be to develop a document covering methods of testing for rating room air conditioners.

It was understandable to the U. S. delegation that the other countries would be more interested in room air conditioners than in unitary equipment, since the development of air conditioning in these countries is far behind the status of the air conditioning industry in the U. S.

A second document that is proposed to be developed in parallel with the testing document will include recommendations on construction and safety. In addition, the subcommittee agreed that it would be necessary to include in the testing document standard rating conditions. The U. S. is the only country where rating standards are developed separately from testing standards so that for international application it is a necessity that rating conditions be included in the single document to be developed.

The ASHRAE Proposed Standard 37 – Methods of Testing for Rating Unitary Air Conditioning Equipment was available to the Subcommittee in draft form as were ARI Standard 110-58 and Nema Standard CN-1-1958 on Room Air Conditioners. These standards were used as a basis for the development of an outline for the international proposal.

The subcommittee requested the secretariat (USA) to prepare a document covering recommendations for such characteristics as safety requirements and performance requirements of room air conditioners. It is to be noted, however, that capacity characteristics will not be included in this document. The U. S. was also requested to prepare, in liaison with subcommittee SC2, a list of suitable definitions to be included in proposals prepared by Subcommittee 6. Since this meeting was the first working meeting of the Subcommittee, the responsibility of the U. S. as secretariat will be to prepare draft proposals for discussion at the next meeting of the Subcommittee. The required procedures of ISO make it necessary that any such proposals be distributed to all members throughout the world several months prior to a meeting of the Subcommittee. For this reason, these subcommittees meet at intervals of about one year between meetings.

Other countries that have already developed standards for room air conditioners are India and Great Britain. In both instances their standards were based on ASHRAE and ARI Standards. This indicates again how important it is for ASHRAE and related trade associations to develop adequate standards which may be considered by other countries or international groups as bases for similar standards.

Subcommittee 3 is concerned with testing of refrigerating systems and Belgium holds the secretariat. The basis of consideration for an international proposal on this subject was the document developed and approved by the International Institute of Refrigeration titled "Recommendations for International Testing Code for Refrigerating Machines." This recommendation was also based on U. S. standards although written in somewhat different form. Because of the international aspect of the work done by IIR, this subcommittee agreed that its document should be acceptable to both ISO and IIR.

One of the basic decisions was that a proposed international stand-

ard in this area should cover only the field testing of systems and possibly of compressors. Again, this approach was decided after comments of the U. S. delegation were presented and discussed.

Subcommittee 4 is concerned with compressors. U. S. standards had been used as a basis for a proposal covering refrigerant compressors. These standards were ASHRAE Standard 23-59 – Methods of Testing for Rating Refrigerant Compressors, and ARI Standard 515-60 – Sealed Refrigerant Compressors and Condensing Units, 20 hp and smaller. It was agreed that any international recommendations on this subject be concerned primarily with methods of factory-testing refrigerant compressors.

The first document developed by this subcommittee will cover single-stage compressors. Multistage compressors will be considered at a later date. Available documents concerning compressor testing were reviewed and it was agreed that the secretariat (Great Britain) would distribute available reports on the subject so that comments from all delegations could be received and included in a new document for review prior to the next meeting of the Subcommittee.

Subcommittee 5 is concerned with household refrigerators and used as a basis for its discussion of the American Standards B38.1 on Food Storage Volume and Shelf Area and B38.2 on Testing Household Electric Refrigerators. There was considerable discussion concerning the specifications for cabinet construction and how this subject should be approached in an international recommendation. This was one of the problems of communication that the U. S. delegation encountered in attempting to indicate how such information in the U. S. would not be included in testing or rating standards.

Since the membership of the Subcommittee was made up of representatives of countries that had tropical as well as temperate climates, the subcommittee decided to classify refrigerators in two groups – those for temperate climates, and those for tropical climates. The first document that will be considered for development by this subcommittee will not concern freezers or gas-operated absorption refrigerators.

The subcommittee also decided that the electrical problems that would be allied with safety should be submitted to the appropriate International Electro-technical Commission (IEC) committee. The suggestions of all delegations were to be considered by the secretariat and a revised proposal developed for review, by mail, by the entire subcommittee.

The activities during these subcommittee meetings as reported above indicate the interest in this general field of refrigeration that exists throughout the world. They also indicate how in each instance the U. S. documents or procedures were considered as desirable bases for not only national but international proposals. The opportunity exists in these international committees for the U. S. to exert positive leadership.

WHO'S WHO IN ASHRAE

Insofar as possible these listings will each appear twice a year

ASHRAE OFFICERS, DIRECTORS, COMMITTEES, STAFF
See page 83, this issue

REGION AND CHAPTER OFFICERS
See page 82, November JOURNAL

RESEARCH AND TECHNICAL COMMITTEES
See page 67, September JOURNAL

STANDARDS PROJECTS
See page 63, July JOURNAL

INTER SOCIETY COMMITTEES
See page 84, November JOURNAL

CHAPTER PUBLICATIONS AND THEIR EDITORS
See page 72, this issue

ASME Holds 81st Annual Meeting

Exhaustively pursuing latest developments in applied mechanics, aviation, gas turbine power, heat transfer, hydraulic systems, machine design, power, production engineering and safety, the 1960 Winter Annual Meeting of the American Society of Mechanical Engineers was once again a scene of intense activities.

Based upon the implausible total of more than 450 scheduled talks, speeches and technical papers, the meeting hurricaned through New York November 27-December 2.

Accompanying, at the New York Coliseum, was the 24th National Exposition of Power and Mechanical Engineering, always one of industry's biggest and most spectacular shows; and this year was no exception to the rule.

Among papers related to the activities of ASHRAE were "Progress in Space Heating with Solar Energy" by C. D. Engebretson of the Whirlpool Corporation and H. G. Asbar of M. I. T., "Solar Energy Steam Generator" by A. R. Yappel of the University of Arizona, "How Safe is Your Design, Installation and Operation of Industrial Ventilation Systems?" by E. M. Schmidt of the Ford Motor Company, "Ventilation of the Eddystone Station" by S. J. Kowalski of the Philadelphia Electric Company, "Dynamics of Steam–Liquid Heat Exchangers" by Arvid Hempel of the Michelsen Institute, "Chemical Cleaning of Controlled Circulation Boilers" by H. J. Vyhnalek of the Cleveland Electric Illuminating Company and "Convection–from Newton to Now" by Professor Myron Tribus of the University of California.

Influence of the house on Chimney draft

A. G. WILSON
Member ASHRAE

Draft is the pressure difference between some point in a venting system and the surrounding air at the same level. It is common to consider draft with respect to outside air, when predicting the draft provided by residential chimneys. But the draft between the base of the chimney or firepot and the surrounding inside air is the one effective in venting connected appliances. Draft requirements and chimney design are usually based on conditions expected when connected appliances operate steadily at rated output, when the difference between draft with respect to outside and inside air may be unimportant. However, a number of appliances, for example, solid-fuel hand-fired furnaces or oil units with pot-type burners, operate at low fire much of the time. Even with gas or mechanically fired oil-burning units there is a period of non-steady flue gas temperature at the beginning of each on-cycle.

Some of the venting problems that arise under these conditions can be understood better by considering the relation between chimney draft and house pressures. In this paper, this relationship is examined and demonstrated by results of some field measurements. Its application to a specific case of venting failure with solid-fuel hand-fired furnaces is discussed. Included, too, are results of field measurements of draft during start-up of a furnace with a high-pressure gun-type burner.

A. G. Wilson is Head, Building Services Sect, Div of Building Research, National Research Council of Canada. This paper was prepared for presentation at the ASHRAE Semiannual Meeting in Chicago, Ill., February 13-16, 1961.

VENTING FAILURE AT LOW FIRING RATE

In the spring and fall, when houses have low heat requirements, draft problems with heating units which can operate on low fire are not uncommon. Appliances under hand control such as oil burning space heaters or solid-fuel hand-fired furnaces, where the combustion rate is modulated roughly to conform to heat requirements, are in this category. Sooting of flue passages with the former and venting failure and fume poisoning with the latter are sometimes reported. These venting failures are often ascribed to down-drafts or unusual atmospheric conditions.

However, in recent investigations in two widely separated housing developments, venting failures were reported during calm, mild periods, often during sleeping hours. The houses, 1½-story units with basements, had gravity warm air heating systems and hand-fired coal-burning furnaces venting into standard lined masonry chimneys located on an exterior wall. Chimneys were 25 ft high with 7⅛-in. square flues inside; smokepipes, about 12 ft long contained a plate damper. Pennsylvania anthracite coal was burned. Venting failure was not reported in similar bungalow units with chimneys located inside the house.

In mild weather ash pit dampers were generally left closed, and air for combustion was admitted through a manual slide in the firing door. Combustion was controlled by manipulating the smokepipe plate damper. Measurements of flue gas temperatures and chimney draft were taken in a number of houses with furnaces operating at low combustion rates. With the smokepipe damper closed, temperature drops of 40, 90 and 140 F occurred in the smokepipes with gas temperatures at the flue collar of 150, 250, and 350 F respectively. With the smokepipe damper open, temperature drops with the same

> At low rates of combustion, during mild, calm weather the relation between chimney draft and house pressures become important.
>
> The author has determined that draft failure will occur if the mean flue gas temperature in the chimney falls below a value that depends on the neutral zone level.
>
> Under the most unfavorable conditions, excluding the effect of wind, draft failure takes place when the mean flue gas temperature in the chimney is less than the mean house temperature.

gas temperatures at the flue collar were increased to 60, 150, and 220 F due to diluent air.

Fig. 1 gives results of the draft measurements related to flue gas temperatures at chimney entry. Values fall within the cross-hatched area; some spread is expected as measurements were taken under differing conditions of flue gas volume. Outside temperatures during the measurements were between 25 and 34 F. Basement temperatures were near 70 F. Draft at the smokepipe plate damper was not measured but would have been less than at the chimney by the amount required to overcome smokepipe pressure losses. Thus, under the conditions shown at the lower end of the graph, venting failure was imminent. Some of the factors contributing to these conditions are apparent, but the actual mechanism by which venting failure occurred can be fully explained only by considering the inter-relation of draft and house pressures.

INTER-RELATION OF DRAFT AND HOUSE PRESSURES

Fig. 2 is a simplified diagram of a two-level house with basement and attached chimney. Elevation l_2 represents the level of the neutral zone where the absolute pressures inside and outside are equal. Elevation l_1 represents the location of any opening between the venting system and the house, such as a smokepipe plate damper, a barometric damper, or a draft hood. Venting failure occurs when the pressure in the venting system at this location, p_{c1}, is greater than the pressure in the house at the same level, p_{i1}. Since pressure p_{c3} at the chimney exit is equal to the outside pressure p_{o3} at the same elevation, l_3,

$$p_{c1} = p_{o3} + w_c (l_3 - l_1) + p_{fc} \qquad (1)$$

where

w_c = mean weight of flue gas, lb per cu ft

p_{fc} = pressure loss in the chimney due to flow resistance, lb per sq ft

The outside pressure at elevation l_1 is

$$p_{o1} = p_{o3} + w_o (l_3 - l_1) \qquad (2)$$

where

w_o = mean weight of outside air, lb per cu ft

The chimney draft with respect to outside air at elevation l_1 is then

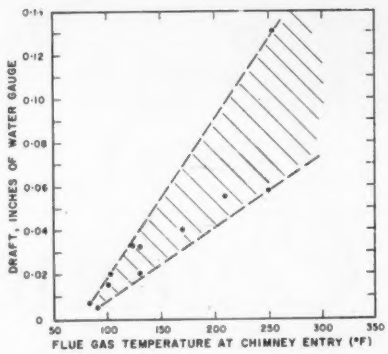
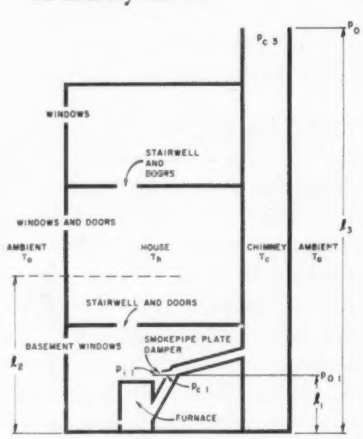


Fig. 1 Draft vs. flue gas temperature at chimney entry

Fig. 2 Simplified diagram of 2-story house



$$p_{o1} - p_{c1} = (w_o - w_c)(l_3 - l_1) - p_{fc} \qquad (3)$$

Similarly, the chimney draft with respect to inside air at elevation l_1, is

$$p_{i1} - p_{c1} = w_o (l_3 - l_2) + w_i (l_2 - l_1) - w_c (l_3 - l_1) + p_{fi} - p_{fc} \qquad (4)$$

where

w_i = mean weight of inside air, lb per cu ft

p_{fi} = pressure loss in the house due to resistance to flow between elevations l_1 and l_2

The resistance to flow between levels within the house is usually negligible and the difference between the chimney draft with respect to outside and inside air is

$$p_{o1} - p_{i1} = (w_o - w_i)(l_2 - l_1) \qquad (5)$$

Equation (4) shows that venting failure and spillage of flue gas into the house from openings at elevation l_1 will occur if

$$w_o (l_3 - l_2) + w_i (l_2 - l_1) \leqq w_c (l_3 - l_1) + (p_{fc} - p_{fi}) \qquad (6)$$

Thus the location of elevation l_2, the neutral zone, has an effect on draft with respect to inside air and is related to draft failure. If elevation $l_2 = l_1$, the draft with respect to inside and outside air will be equal at elevation l_1 and will be zero when the mean temperature of the flue gas in the chimney, T_c, is equal to the outside temperature, T_o, ignoring friction effects.

Similarly, if elevation $l_2 = l_3$, the draft will be zero when T_c is equal to the mean temperature in the house, T_i. If there is flue gas flow in the venting system, friction losses must be overcome. These limits of mean flue gas temperature, below which venting failure occurs, will be correspondingly higher. An increase in the mean flue gas temperature of approximately 10 F would normally be adequate to overcome these friction losses with the small flue gas volumes involved when venting failure is imminent.

Wind pressures may affect the neutral zone location, and, in addition, will usually have some direct effect on pressures at the chimney exit. Wind effects are beyond the scope of this paper. Under calm or low wind conditions, the level of the neutral zone will usually be at some elevation between l_1 and l_3 and will depend on the location and characteristics of the openings between the house and outside.

Data on the location of the neutral zone in houses are limited. Available records indicate that it may often be well above the mid-height of the heated structure. It follows that opening basement windows will have a beneficial effect on draft, but openings at upper levels may affect draft adversely. Appliances that exhaust air from the house have the same effect as openings above the neutral zone. In a tight house these might lower house pressures below outside pressures at all levels, creating an imaginary neutral zone above the heated structure. It will be recognized that the chimney itself represents one of the upper openings. In a tight house or enclosure the chimney might have an effect on the neutral zone similar to a mechanical exhaust unit.

The mechanism of draft failure described previously applies directly to conditions found at the housing developments referred to.

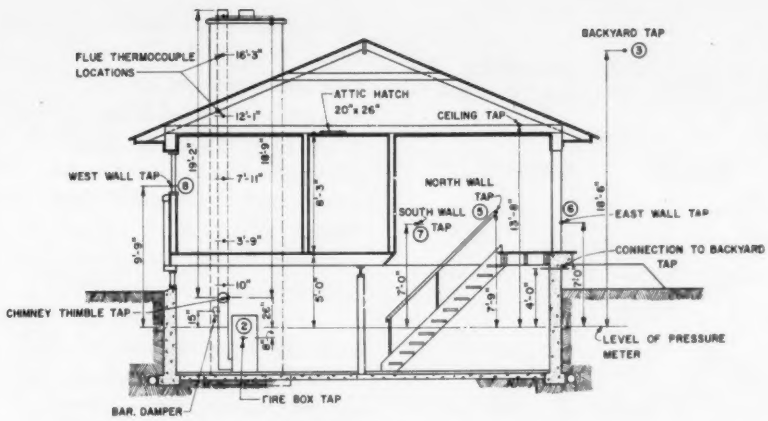


Fig. 3 Location of pressure taps and chimney thermocouples

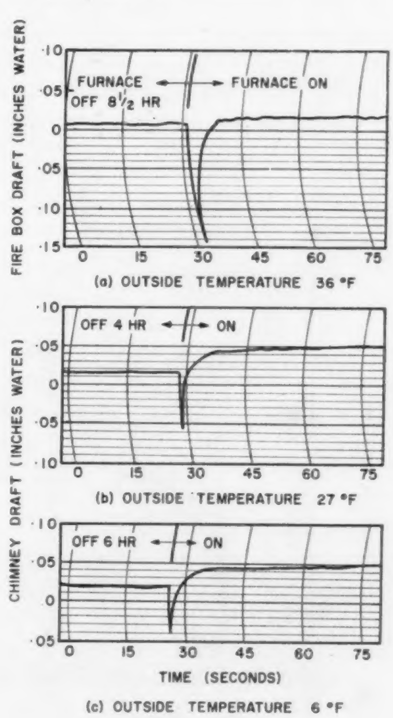
It can be assumed that the neutral zone was at an upper level in the house, particularly at night when upstairs windows are open, and at times the mean flue gas temperature fell below the critical value defined by Equation (6). It is clear that to avoid this cause of venting failure the mean flue gas temperatures in the chimney cannot fall much below mean house temperature.

Several factors contributed to the lowering of mean flue gas temperature below this value. Low rates of combustion, dilution of flue gases at the smokepipe plate damper, and cooling of the flue gases in the long smokepipes resulted in relatively low flue gas temperatures upon entrance to the chimney. These temperatures were still higher, however, than the house air, and the effect of cooling the flue gas in exposed outside chimneys must be considered the ultimate cause of draft failure.

The temperatures at the exit of the chimneys where venting failure occurred were not measured. Subsequently, however, some temperature records were obtained for three chimneys of similar construction venting oil burning furnaces. Two of these chimneys were on outside walls, one 27 ft and the other 19 ft high. The third was an inside chimney 22 ft high; 12 ft within the heated structure, 7 ft in the attic, and 3 ft above the roof. Following an 8-hr burner-off period, when outside temperature was 40 F, the flue gas temperatures at chimney exit were 47, 48, and 65 F, respectively. Venting failure of the type described, with solid-fuel hand-fired furnaces, is unlikely to develop when inside chimneys are used.

Similar venting problems can be expected when heating units burning other fuels operate at low or pilot fire during mild weather, although spillage of the products of combustion into the house might not be regarded so seriously. It follows that inside chimneys would also be advantageous in these instances. On the other hand, mechanical oil-burning furnaces operate at rated input on heat demand, regardless of the outside temperature, and the same problem of venting failure due to low flue gas temperatures does not occur. However, the draft condition during start-up of such furnaces, and the extent to which this is affected by the draft prior to start-up, are of special interest. Since the average temperature of gas in the chimney can be relatively low, the effect of house pressures on the chimney draft prior to starting of the burner is next considered.

Fig. 4 Draft during furnace start-up, following extended off periods



MEASURING CHIMNEY DRAFT AND HOUSE PRESSURES

Measurements of chimney draft and house pressures were made in a single-story house with basement, heated by a forced warm-air system with high-pressure gun-type oil burner. The house had a floor area of 1200 sq ft and was well insulated, with plaster finish throughout. Storm windows and doors and weatherstripping were used. There was a covered hatch in the hall ceiling leading to a vented attic.

The chimney was on an outside wall and exposed to the weather on three sides. It was constructed of single layer brick with clay-tile flue liners and contained a nominal 8- by 8-in. flue serving the furnace and a nominal 8- by 8-in. flue serving a fireplace. The furnace room was open to the basement which was interconnected to the main floor through the return air system. The oil burner was equipped with a 0.75-gph nozzle and the air supply was adjusted to give No. 2 smoke spot with about 5% CO_2. The flue pipe was 6 ft long and contained a barometric damper, which was partly open even when the furnace was off.

Pressure taps were located in the cap of the combustion chamber sight-port to measure overfire draft, in the flue pipe at chimney entry to measure chimney draft, in the four outside walls and ceiling to measure pressure differences across the building enclosure, and at an outside pressure station in the backyard approximately 80 ft from the rear of the house. Pressure measurements were made with an electric capacity-type differential pressure meter. This provided a current output proportional to pressure, which was measured on a galvanometer-type recording milliammeter. The pressure meter was

TABLE I

HOUSE PRESSURE VS. BACKYARD, ATTIC AND CHIMNEY AS AFFECTED BY HOUSE OPENINGS, WITH FURNACE OFF

Arrangement of Openings	Pressure Differences, In. of Water				
	Backyard (3)		Attic (4)		Chimney (1)
	$T_i = 72$ F $T_o = 27$ F	$T_i = 70$ F $T_o = 6$ F	$T_i = 72$ F $T_o = 27$ F	$T_i = 70$ F $T_o = 6$ F	$T_i = 72$ F $T_o = 27$ F
Openings closed	—0.005	—0.018	0.005	0.010	0.016
Basement window open	0.000	—0.003	0.016	0.025	0.027
Attic hatch open			0.000		0.011
Fireplace damper open		—0.023		0.006	

TABLE II

HOUSE PRESSURE VS. CHIMNEY AND OUTSIDE WITH FURNACE OFF AND ON

$T_i = 70$ F $T_o = 6$ F	Pressure Differences, in. of water							
	Chimney (1)	Overfire (2)	Backyard (3)	Attic (4)	North (5)	East (6)	South (7)	West (8)
Furnace off	0.020	0.019	—0.018	0.011	—0.007	—0.010	—0.008	0.000
Furnace on	0.065	0.035	—0.023	0.007	—0.012	—0.013	—0.012	—0.004

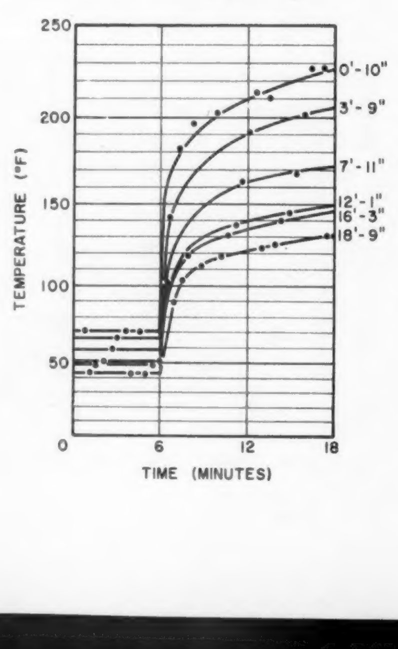
sensitive to pressure charges of less than 0.001 in. of water and was calibrated against a laboratory micromanometer having a corresponding accuracy. The zero-position of the meter, however, drifted with temperature and line voltage fluctuations and frequent checking was necessary.

Flue gas temperatures in the chimney, along the center of the flue, and outside temperature were measured with copper-constantan thermocouples connected to a 16-point electronic temperature recorder. Location of the chimney thermocouples with respect to the center of the chimney thimble and location of pressure taps with respect to the level of the pressure meter are shown in Fig. 3. Inside air temperature was measured with a calibrated thermograph at one location only, in the living room approximately 2½ ft from the floor. This has been taken as the mean house temperature in subsequent calculations.

Table I shows, for two different outside temperature conditions, the effects of openings to the outside at different levels on house pressure (at the meter) relative to backyard, attic and chimney pressures. These records were obtained on relatively calm days, during periods when the furnace was off.

When there is no wind, the pressure reading obtained with the meter connected to tap 3 is equivalent to the pressure difference across the building enclosure at the level where the connection from inside to outside is made. If there is wind, the reading merely represents basement pressure with reference to the backyard tap. The reading obtained with the meter connected to tap 4 is equivalent to the pressure difference across the ceiling. The house chimney effect required to produce these pressure

Fig. 5 Chimney temperatures at furnace start-up



differences can readily be calculated from the difference in density between inside and outside air, and a neutral level established with reference to the pressure taps; although where the pressure differences are extremely low, small errors in pressure or air density can lead to significant errors in the calculation.

From the results for an outside air temperature of 27 F, the neutral level, calculated with reference to the attic pressure, is approximately 4 ft below the ceiling with the basement window shut, and approximately 12 ft below the ceiling with it open. This shift of the neutral level below the basement window can be explained by outside wind pressure. There is a corresponding increase in chimney draft with the basement window open. It is anomalous that the basement pressure measured with respect to the backyard tap did not increase to the same extent when the basement window was opened.

Opening the attic hatch raised the neutral zone to the ceiling level and had a corresponding effect in lowering chimney draft. A similar study of the results for an outside air temperature of 6 F indicates that opening the basement window lowered the neutral level approximately 7½ ft, while opening the fireplace damper raised it approximately 2½ ft.

Table II gives some additional pressure measurements, taken under the same conditions as those in Table I for an outside temperature of 6 F. Calculated neutral levels vary from 3½ ft below the ceiling with reference to the west wall to 1 ft below the ceiling with respect to the east wall, indicating some easterly wind effect. Similarly, the neutral level is 5½ ft below the ceiling with reference to the attic tap and at the ceiling with respect to the backyard tap. With the furnace on and other conditions the same, the neutral level is approx 2 ft higher with reference to all taps, a result of the increased flow up the chimney.

It should be pointed out in connection with calculated neutral pressure levels, that the house had a total door and window crackage of about 260 lineal ft. Basement windows, not well weatherstripped, represented 35 ft. Living room

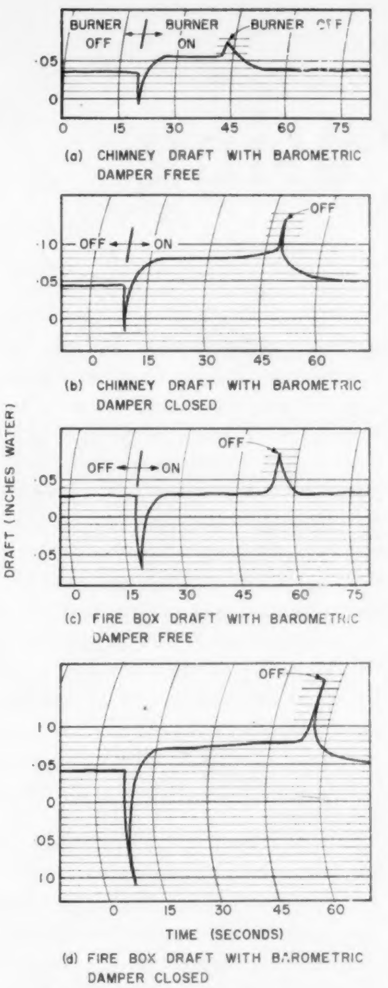


Fig. 6 Draft during burner start-up following normal furnace operation with outside temperature at 5 F

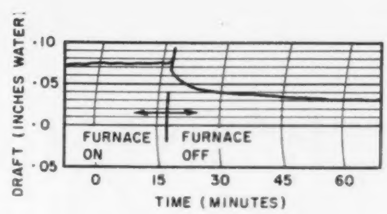


Fig. 7 Chimney draft after burner shut-down with outside temperature 27 F

windows were fixed and ventilation was provided by louvred openings with weatherstripped covers just above floor level, contributing 40 ft. Thus, there may have been more cracks immediately above and below the floor than is usual, and neutral levels may have been correspondingly lower.

Table III presents some further records of the effect of house openings on chimney draft under mild weather conditions. With the furnace off, opening of the basement window raised the draft about 0.006 in. of water, while opening the attic hatch lowered it by about 0.005 in. of water. With the furnace on, the effect of opening the window is somewhat greater, while opening the attic hatch has a lesser effect.

TABLE III

EFFECT OF HOUSE OPENINGS ON CHIMNEY DRAFT

$T_i = 72$ F	Chimney draft, in. of water	
$T_o = 36$ F	Furnace off	Furnace on
Openings closed	0.010	0.066
Basement window open	0.016	0.075
Fireplace damper open	0.005	0.063

DRAFT DURING BURNER START-UP

Several tests were made with this same installation, in which the chimney or overfire draft was recorded during burner start-up. Fig. 4 gives the results following extended furnace-off periods at different outside temperatures. The accuracy of these measurements of transient draft has not been established. The galvanometer pen was delicately balanced to minimize drag, and the galvanometer was critically damped to eliminate overshooting. Any errors are thought to be mainly in the measurement of extremes in pressure when pressures were rapidly reversed.

Fig. 4(a) indicates that substantial positive pressures can occur for a brief period in the fire box when the burner-blower first starts. Maximum pressure measured in this test was just under 0.15 in. of water. Draft failure in the fire box occurred for about 5 sec. In this instance, the furnace had been off overnight and the temperature in the center of the flue varied from 69 F at the bottom to 49 F at the top prior to burner start-up. The chimney draft was 0.010 in. of water, as shown in Table III. Fire box draft after burner start-up surpassed that prior to start-up in about 6½ sec.

Figs. 4(b) and 4(c) show the extent of positive pressure at the base of the chimney during burner start-up following extended periods with the furnace off. Temperatures from bottom to top of the chimney were 77 to 61 F and 70 to 43 F, respectively. Draft failure at the base of the chimney existed for about one sec in both instances. Chimney draft with the burner operating exceeded that with the burner off after 2½ sec. Draft build-up was relatively rapid in all cases.

There was a corresponding rate of increase in chimney flue gas temperature, as shown in Fig. 5 for the conditions of Fig. 4(c). The curves from top to bottom represent the temperatures at the thermocouple positions shown in Fig. 2, in order, from the bottom to top of the chimney. The print and chart speed of the temperature recorder were not sufficiently fast to show the precise pattern of temperature change during the first few seconds of furnace operation.

As mentioned earlier, the barometric damper was partly open even when the furnace was off. This no doubt led to higher chimney temperatures than would have occurred otherwise, during extended periods with the furnace off. The position of the barometric damper also affected the maximum pressures at the base of the chimney and in the fire box during burner start-up. This can be seen in Fig. 6, which gives the results of chimney and fire box draft measurements with the barometric damper in its normal free position and taped closed. All results in this figure were obtained within a short period under essentially the same conditions.

In each case the furnace was allowed to run for less than one min and the system allowed to cool until the chimney draft returned to its original value, with the barometric damper free, before beginning another on-cycle. The outside temperature was 5 F and the burner had been cycling normally before the measurements were taken, accounting for the relatively high chimney draft prior to each burner start.

Higher positive pressure occurred both in the fire box and at the base of the chimney when the barometric damper was closed, indicating that these pressures are relieved, to some extent, by gas flow out of the barometric damper. The rate of draft recovery was somewhat greater with the barometric

(*Continued on page* 99)

Research fund raising

ALBERT GIANNINI
Chairman
ASHRAE
Research Fund Raising Committee

As reported in the President's Page in the November 1960 JOURNAL, by Treasurer John E. Dube, the Research Budget for the 1960-61 fiscal year is $200,000. As you know, our Society is unusual in that we conduct an extensive research program primarily through our own laboratory in Cleveland, and also through grants to universities.

Forty thousand dollars of this $200,000 is expected to be contributed by industry. This would be approximately the same amount given by 142 firms last year. The list of these 1959-60 contributors was published in the September 1960 issue of the JOURNAL, and consists of individuals, corporations and associations.

The balance of the Research Budget is financed by an allocated percentage of the membership dues, government agencies for unclassified research of broad interest and a contribution derived from the biennial International Heating, Ventilating and Air-Conditioning Exposition.

ASHRAE research solves problems of common concern to the heating, refrigerating, ventilating and air-conditioning professions. Currently, the most important work being done by our laboratory is in the field of environmental research (see November 1960 JOURNAL). This research program produces information which benefits all segments of our profession and industry and which is not available from any other source.

On the agenda for the immediate future are studies in:

a. Effect of Work Rate or Activity on Human Comfort.
b. Effect of Environmental Conditions on Human Productivity.
c. Effect of Environmental Conditions on the Learning Rate.

Industrial plants throughout the country represent an enormous potential market for air conditioning. Although many companies feel that they cannot justify the cost of air conditioning entirely on the basis of worker comfort, a number would consider installation immediately if it could be shown that air conditioning would pay for itself in a reasonable time through increased worker productivity.

There is a general feeling that air conditioning will improve worker efficiency and several tests made in the field have substantiated this impression. However, requests have come from many segments of the industry for research under controlled conditions, which will provide a definite and quantitative answer to the problem.

At present, the educational facilities of this country are overcrowded badly because of the population explosion during the last decade. At the same time, the entire educational system is being studied carefully to find means of accelerating it and making it more effective. Yet, in spite of the serious building shortage which exists, and the demand for the speeding up of our educational programs, most of our educational facilities, from primary grades through the college level, are used only about nine months of the year.

There are many who feel that at least a part of the solution to this problem may be obtained by the installation of air conditioning in existing and new school buildings. Certainly if the buildings could be made usable twelve months of the year by controlling the thermal environment in them, the building shortage would be relieved. However, the advantage of air conditioning might extend far beyond the mere improvement of the building occupancy factor. By being able to maintain an environment conducive to study and learning, the general effectiveness of the educational program might be improved.

It is this general feeling that has prompted the requests received by the Laboratory for a research program to determine the effect of thermal environment on learning rate. The proposed project is a challenging one and definite steps are being taken toward its activation.

As evidenced from the 1959-60 list of contributors, Industry has welcomed the opportunity to contribute to the Society's Research Program. The Fund Raising Committee is appreciative of these contributions and would like to see new names added to the list for this year and the future. It is suggested that all members do whatever they can to acquaint their companies with our research activities so that these firms will soon be able to include funds for ASHRAE research in their annual budgets.

J. H. Cansdale, ASHRAE Assistant Secretary—Public Relations and Fund Raising, at 234 Fifth Avenue, New York 1, N. Y., will be happy to supply you with further information regarding our Research Program or to accept your contributions. Remember, contributions to ASHRAE research are tax-exempt. Checks should be made payable to ASHRAE Research Fund.

ASHRAE JOURNAL

Editorial Index for 1960

VOLUME 2 — Names of authors appear in capitals, subject classifications in italics

ASHRAE CHAPTER PUBLICATIONS AND EDITORS

CHAPTER	PUBLICATION	EDITOR
		REGION I
Boston	Northeastaire	William T. Chaisses, c/o Capitol Eng. Co., 75 Rogers St., Cambridge, Mass.
Central New York	The Central New Yorker	E. J. McNally, Johnson Service Co., 19 Eastern Ave., E. Syracuse, N. Y.
Niagara Frontier	Heat & Real Cool E-vents	H. J. McLaughlin, Insulation Dist., Inc., 220 State St., Buffalo 5, N. Y.
		REGION II
Montreal	Montrealer	Henry J. Mattocks, Ross, Fish, Duschenes & Barrett, 4115 Sherbrooke St. W., Montreal, Que., Can.
Ontario	Ontario ASHRAE Gazette	Kenneth W. Gould, Age Publications Ltd., 450 Alliance Ave., Toronto 9, Ont., Can.
		REGION III
National Capital	The Capitalaire	W. C. Reamy, Meleney Engrg. Co., 720 Mills Bldg., Washington 6, D. C.
		REGION IV
No Chapter Publications		
		REGION V
Central Indiana	The Hoosier Pacesetter	Patrick O. Patterson, Patterson Metal Fabricators, 6300 N. Oakland Ave., Indianapolis 20, Ind.
Cleveland	Cleveland Chapter Newsletter	H. A. MacNair, 1900 Superior, Cleveland, Ohio
Columbus	ASHRAE Journalette	J. W. Hensel, 729 S. Brinker Ave., Columbus, Ohio
		REGION VI
Minnesota	Minnesota Exchanger	W. J. Balchunas, W. Lake & Monk Ave., Hopkins, Minn.
Wisconsin	Badgeraire	Geo. A. Adlam, 5629 W. Washington Blvd., Milwaukee 8, Wis.
		REGION VII
Kansas City	The BTU Breeze	W. K. Dyer, Buffalo Forge Co., P.O. Box 966, Mission, Kansas
Louisville	Bluegrass Bugle	R. W. Sexton, Jr., American Air Filter Co., Inc., 215 Central Ave., Louisville, Ky.
New Orleans	Delta Digest	H. N. Stall, Lamott Agency, Inc., 840 Baronne St., New Orleans, La.
		REGION VIII
Alamo	The Squirrel Cage	R. W. Kotzebue, Jr., 149 Lou Jon Circle, San Antonio 13, Tex.
Arkansas	ASHRAE Arkansas Engine Aires	
Austin	Austin Register	W. H. Luedecke, Luedecke Engrg. Co., 1007 W. 34th St., Austin 5, Tex.
Central Oklahoma	The Sou'wester	F. R. Denham, Carnahan & Thompson Engrs., 320 Oklahoma Natural Bldg., Oklahoma City 2, Okla.
Dallas	Texas Norther	C. H. Newby, Sterling & Newby, 4431 Maple Ave., Dallas, Tex.
Fort Worth	The Therm	T. R. McMurry, Farwell Co., P.O. Box 7668, Dallas 26, Tex.
Houston	Hot Air Recorder	J. E. Burton, 5611 Jackson St., Apt. 2D, Houston 4, Tex.
Northeastern Oklahoma	The Oil Capital Air	Virgil E. Carrier, 5355 E. 30th St., Tulsa, Okla.
Shreveport	The Flue Pipe	John J. Guth, Jr., Malahy & Guth, Cons. Engrs., 330 East Kings Hwy., Shreveport, La.
		REGION IX
New Mexico	Thin Aire Bulletin	J. L. Desilets, 2252 A 36th St., Los Alamos, N. Mex.
Rocky Mountain	Rocky Mountainaire	W. C. Griggs, Buffalo Forge Co., 655 Broadway Bldg., Denver, Colo.
		REGION X
British Columbia	The British Columbia Totem	W. A. Mullett, Industrial Sheet Metal Works Ltd., 1475 E. Georgia St., Vancouver 6, B. C.
Central Arizona	Central Arizona Newsletter	R. H. MacFarland, 502 W. Orchid La., Phoenix, Ariz.
Golden Gate	Fog Dispenser	T. E. Brewer, California Hydronics Corp., 910 Howard St., San Francisco, Calif.
Inland Empire	The Guidette	W. C. Spurr, 1643 Glass, Spokane 27, Wash.
Oregon	The Oregon Diffuser	E. A. Starr, 635 Tenth St., Oswego, Oregon
Southern California	Sol-Air	Hans Sommer and Richard Finley, Minneapolis-Honeywell Regulator Co., 6620 Telegraph Rd., Los Angeles 22, Calif.

They Wanted to Know

Inquiries of the month to ASHRAE Headquarters covered many points as to technical facts, standards, practices, personnel and published references. From these, the following have been selected and condensed as being those replies of some general interest and value to ASHRAE members.

PROBLEMS WITH REFLECTIVE INSULATION

To ASHRAE:

Must reflective insulation always be adjacent to air space and must it face inward to be effective insulation during the heating season? If the reflective face, assuming it still has air space, is toward the outside, does it still serve as insulation? Are values for thermal conductance or resistance (page 98, 1959 ASHRAE GUIDE) not dependent on maintenance of emissivity in construction the same as at the time of the test, or in other words, does dust on the bright sheets radically reduce thermal resistance?

H. I. K.

Reflective insulation must always be adjacent to air space, since it is the air space, not the reflective surface that provides insulation. The reflective surface merely, by reducing radiant heat flow, aids in taking advantage of the air space. The method for calculating heat flow across a reflective space, according to the National Bureau of Standards, Washington, D. C., is to determine the heat transferred by convection and conduction and, adding to this, heat flow by radiation. It makes no difference which side of the air space has the reflective surface, for one side reflects radiant heat within the air space, while on the other side low emissivity reduces heat radiated in the same amount as the reflective surface, had it been on the opposite side. Considering radiant heat (infra-red radiation or reflection) in a construction cavity, reflectivity or emissivity always equals 100%. For example, if reflectivity is 95%, emissivity of surface is 5%. This means that the surface will reflect 95% of the radiant heat striking it when placed in a wall adjacent to an air space, or if the reflective surface is at the higher temperature, only 5% of the radiant heat will be emitted from it across the space. As for the conductance values listed in the ASHRAE GUIDE, they are design values, selected by the ASHRAE Technical Committee 1.11, as representative, based on published data obtained by the guarded hot-box method (ASTM-236-54T). Probably commercial products will have some variation. Also the method of installation and attachment can be important, since convection air currents escaping from one air space to another can be detrimental to the conductance value. Dust has a negligible effect on thermal value of reflective insulations. Many materials looking dull and gray have been found to have a rather high infra-red reflectivity when checked with a emissivity meter. Naturally when the reflective materials appear badly damaged, some correction must be made.

TEMPERATURE TO FREEZE BAKERY PRODUCTS

To ASHRAE:

The 1956-1957 ASRE AIR CONDITIONING, REFRIGERATING DATA BOOK does not give actual temperatures at which to freeze bakery products. Specifically, I am interested in the recommended temperatures for pastry.

D. R. R.

The 1959 DATA BOOK contains considerable material on refrigerating, freezing and handling food products. Chapter 8 refers to bakery products and the following is from that volume: bread freezes at 18 to 20 F, but it is necessary to pull it through freezing as fast as possible in order to preserve cell structure. Room temperatures of 0, —10, —20 and —30 F have produced successful freezing, but there has been no definite correlation of comparative results from commercial applications at these various temperatures. Optimum design bases for a quick freezer include (a) individual wrapped loaves spaced at least one in. apart on open wire grids for good air circulation over every surface, (b) highly turbulent air circulation throughout the room based on a 500 to 700 fpm velocity over the bread, (c) —20 F air temperature, (d) two hr freezing time. Temperature of 0 —10 F apparently produces as satisfactory results for cakes, pies and dough products as —10 to —20 F does for bread and rolls.

PREVENT ODOR TRANSFER IN COLD STORAGE

To ASHRAE:

Does your DATA BOOK have anything on the subject of the transfer of odors from one food product to another in cold storage?

D. F. M.
Vancouver, B. C.

Experience has shown that the transfer of odors from one food product to another is affected by the type of package, the type of product and the temperature. If food is packaged in hermetically sealed moisture-vapor-proof containers, odors will not be transmitted into storage space. Examples of differences in types of products is seen by comparing the tendency of pecans to absorb odors more readily than peanuts, which in turn are more susceptible than seeds with lower oil content. Transfer of odor is completely stopped if the refrigerating temperature is held at zero, except in rare instances (only after long storage do pecans absorb the odors of onion or fish when held side by side at zero F or lower). Another fact in low temperature storage is that the vapor pressure is proportional to the temperature, so that the lower the temperature the less vapor pressure exists, and there is less tendency for the water vapor or gases that are responsible for the odors of foods to leave the food itself, as long as the temperature of the surroundings is held reasonably steady.

TO DEEP FREEZE GRASS

To ASHRAE:

I shall appreciate information about experiments and literature available in America on the problem of deep-freezing grass to serve as food for milk cows.

R. A.
Lucerne, Switzerland

We know of no such research being done in this country, but there is a project at the Reading Experiment Station in England.

MAP SHOWING MAX TEMPERATURES IN MAIN CITIES IN U.S.

To ASHRAE:

We are interested in obtaining a map of the United States showing the max temperatures in the various localities, principally the main cities of each state, in chart form. We understand the ASHRAE HEATING VENTILATING AIR CONDITIONING GUIDE has this material, without the chart.

L. W. Y., Jr.

You are correct in assuming that max temperatures for various localities appear in the GUIDE, and that a map does not. The U.S. Weather Bureau report "Climatological Data", available from the Bureau in Washington or any principal regional office, should be consulted.

NEXT MONTH—

Preview issue for ASHRAE Semiannual Meeting in Chicago February 13-16.

What you may expect in coming National Meeting programs, a forecast by Program Committee Chairman R. A. Line.

Also, the Chicago Program Abstracts of Technical Session papers and Summaries of Symposiums and Forums.

Your Chapter's Score as of November 8, 1960

ASHRAE FAR SHORT OF $250,000 QUOTA

Region	Chapter	No. of Members	Quota	No. of Members Contributed	Contrib. To Date
I	Long Island	162	$ 2,445	8	$ 280.
	New York	707	10,605	29	1,015.
	North Jersey	511	7,665	16	292.
	Northeastern N.	120	1,800	3	60.
	Boston	393	5,895	9	286.
	Central N. Y.	267	4,005	10	178.
	Niagara Frontier	186	2,790	4	255.
	Northern Conn.	137	2,055	1	300.
	Rhode Island	99	1,485	2	40.
	Rochester	116	1,740	0	0
	Southern Conn.	584	8,760	2	110.
	Western Mass.	81	1,215	4	615.
	TOTAL	3364	$50,460	88	$3,431,
II	Quebec	48	$ 720	0	$ 0
	Manitoba	64	960	2	70.
	Montreal	331	4,965	6	231.
	Niagara Peninsula	87	1,305	0	0.
	Northern Alberta	60	900	0	0
	Ottawa Valley	98	1,470	0	0
	Southern Alberta	61	915	1	20.
	Ontario	576	8,640	2	25.
	TOTAL	1325	$19,775	11	$ 346.
III	Baltimore	319	$ 4,785	6	$ 170.
	Central Pa.	124	1,860	5	114.
	Johnstown	90	1,350	3	57.
	National Capital	247	3,785	12	210.
	Philadelphia	646	9,690	38	1,127.
	Pittsburgh	245	3,675	13	474.
	Richmond	123	1,845	3	86.
	Hampton-Roads	46	690	0	0.
	TOTAL	1840	$28,680	80	$2,250.
IV	Atlanta	202	$ 3,030	1	$ 50.
	Fla. West Coast	91	1,365	2	15.
	Jacksonville	106	1,590	0	0.
	Savannah	40	600	0	0.
	South Florida	142	2,130	4	135.
	North Piedmont	114	1,710	2	45.
	South Carolina	88	1,320	1	15.
	South Piedmont	87	1,305	88	$1,516.
	TOTAL	870	$13,050	98	$1,776.
V	Cleveland	374	$ 5,610	11	$ 239.
	Columbus	224	3,360	5	105.
	Toledo	112	1,680	2	15.
	Central Indiana	206	3,090	5	195.
	Cincinnati	241	3,615	8	240.
	Dayton	193	2,895	5	55.
	Evansville	125	1,875	2	35.
	TOTAL	1475	$22,125	38	$ 884.

Region	Chapter	No. of Members	Quota	No. of Members Contributed	Contrib. To Date
VI	Illinois	885	$13,275	26	$1,165.
	Illinois-Iowa	102	1,530	8	170.
	Iowa	94	1,410	5	210.
	Minnesota	448	6,720	46	1,263.
	Wisconsin	326	4,890	5	145.
	Central Mich.	122	1,830	2	110.
	Michigan	519	7,785	8	141.
	Western Mich.	141	2,115	1	75.
	TOTAL	2637	$39,555	101	$3,279.
VII	Louisville	172	$ 2,580	5	$ 67.
	New Orleans	179	2,685	41	756.
	Baton Rouge	54	810	1	15.
	Kansas City	249	3,735	9	275.
	Mobile	38	570	0	0
	North Alabama	101	1,515	1	10.
	Memphis	67	1,005	8	115.
	Middle Tenn.	128	1,920	3	55.
	Mississippi	49	735	0	0
	St. Louis	406	6,090	32	1,076.
	TOTAL	1443	$21,645	100	$2,370.
VIII	Alamo	63	$ 945	1	$ 25.
	Austin	55	825	0	0
	Houston	204	3,060	4	40.
	Shreveport	54	810	1	20.
	Arkansas	47	705	1	112.
	Cent. Oklahoma	116	1,740	77	2,150.
	Dallas	301	4,515	5	249.
	Fort Worth	73	1,095	0	0
	Northeastern Okla.	69	1,035	1	60.
	West Texas	45	675	0	0
	TOTAL	1027	$15,405	90	$2,658.
IX	El Paso	28	$ 420	0	$ 0
	Kansas Chapter/ Wichita Section	131	1,965	1	150.
	Nebraska	109	1,635	2	275
	Rocky Mountain	196	2,940	1	25.
	Utah	64	960	0	0
	New Mexico	82	1,230	5	144.
	TOTAL	610	$ 9,150	9	$ 594.
X	Brit. Columbia	170	$ 2,550	0	$ 0
	Inland Empire	75	1,125	2	15.
	Oregon	228	3,420	3	106.
	Puget Sound	221	3,315	14	285.
	Cent. Arizona	84	1,260	1	10.
	Golden Gate	352	5,280	30	529.
	Sacramento Valley	95	1,425	1	15.
	San Diego	69	1,035	4	72.
	San Joaquin	44	660	0	0
	Southern Calif.	584	8,760	13	500.
	Tucson	59	885	0	0
	TOTAL	1981	$29,715	68	$1,532

Four engineering societies . . . ASCE, AIChE, AICE and AIIndE . . . which will share facilities with ASHRAE in the new United Engineering Center, have exceeded their quotas in the fund-raising drive in support of the building. Other societies and fellow tenants are rapidly nearing the achievement of their goals. ASHRAE still lags $222,344 short of its quota.

The tabulation on the facing page reveals the progress made by each of ASHRAE's 88 chapters. But, only two have achieved their quotas . . . Central Oklahoma and South Piedmont. The former waged a person-to-person fund-raising campaign and in a relatively short period exceeded its set goal by $410. The latter, South Piedmont, decided to raise its quota by contributing funds from its treasury. The established quota here was $1,305 of which there has been contributed $1,500 to be paid over a three-year period. If these two relatively small chapters can achieve their quotas, certainly the remaining chapters can do so. All it requires is enthusiasm and professional pride.

In recent weeks, construction on the Center has proceeded rapidly. Steel and stone have already begun to enclose the lower floors and work on internal facilities is proceeding. The contrast between the progress in fund-raising by our chapters is strikingly poor.

Look at your chapter's record, call your local officers and offer your help to put this over the top. In recent weeks, a number of chapters have organized fund-raising committees. These need your support and your contribution in dollars.

The headquarters staff of ASHRAE expects to relocate in the new Center in July of next year. At the present time, the staff is occupying inadequate quarters at two locations in New York. The move in July will enable the two groups to be housed together, with resultant benefits to all the members of the Society from a more efficient working arrangement.

Those other societies which will occupy the Center have worked hard to contribute their fair share in supporting the building fund. They have exhibited pride in their professions and their staffs will reflect this pride. What about YOUR professional pride? MAKE YOUR PLEDGE TODAY!

For your convenience a contribution pledge form is incorporated within this page. Mail to ASHRAE, 234 Fifth Avenue, New York 1, N. Y.

UEC FUND RAISING COMMITTEE
Merrill F. Blankin, *Chairman*
W. J. Collins, Jr., *Vice-Chairman*
Thomas E. Brewer
John E. Haines
Clifford F. Holske

NAME ....

ADDRESS ....

IN CONSIDERATION OF THE GIFTS OF OTHERS INTENDS TO GIVE TO

UNITED ENGINEERING CENTER BUILDING FUND

..................................DOLLARS $..........

BALANCE TO BE PAID QUARTERLY $........, SEMIANNUALLY $........

ANNUALLY $........, OR AS FOLLOWS ....

SIGNED ....
MEMBER ASHRAE

CHECK MAY BE MADE PAYABLE TO UNITED ENGINEERING TRUSTEES, INC.
29 WEST 39TH STREET, NEW YORK 18, N. Y.
GIFTS ARE DEDUCTIBLE FOR INCOME TAX PURPOSES

FIFTY THREE CHAPTERS REPRESENTED AT SIX REGIONAL MEETINGS

Fifty three ASHRAE chapters from 25 states were represented by delegates and alternates at six Chapters Regional Committee Meetings, held in October and November by Regions I, III, IV, V, VI and VII. These were the first regional meetings of the 1960-61 fiscal year. The remaining four will take place next spring for Regions II, VIII, IX and X.

Although discussions of chapter progress and problems play an important part at these meetings, the basic reason for their existence evolves around the propagation of the Society's essential structure: the election of a member and an alternate to the Society's Nominating Committee; recommendation of names for regional directors; recommendation of candidates for officers and directors at large; recommendation of names for general and technical advisory committees; and the extending of invitations for 1961-1962 Chapters Regional Committee Meetings.

Talked over at the meetings were Chapter By-laws, attendance at meetings, programs, speakers, membership, rosters, publications and communications. Special discussions regarding public relations and fund raising, for both the new United Engineering Center and the Society's Research Laboratory, were led by J. H. Cansdale, Assistant Secretary—Public Relations and Fund Raising.

Featured at all meetings was a speech by John Everetts, Jr., 2nd vice president and chairman of the Regions Central Committee, on "The Regional Plan, Its Scope and Influence."

Among the officers and staff members who attended and participated in one or more of the meetings were Walter A. Grant, President; John H. Fox, Director-at-large and nominee for Second Vice President; John E. Dube, Treasurer; R. C. Cross, Executive Secretary; and F. W. Hofmann, Assistant Secretary-Membership. President Grant, guest speaker at banquets in Boston, Williamsburg, Des Moines and Kansas City, spoke on "Inside ASHRAE."

The first of the 1960-61 meetings was held in Boston on October 10th and 11th, conducted by Walter Heywood, Director of Region I. This meeting was coupled with a Regional Conference, highlighted by three technical talks and a banquet attended by members and their wives. Frank W. Crimp of the Boston architectural firm of Clinch, Crimp, Brown & Fisher spoke on "Problems Confronting

Robert E. Reid, fifth from left, front row, delegate and president of the Boston Chapter, is flanked by other delegates and alternates at the Region I meeting. Pictured are: R. B. Taylor and L. M. Brown, Northeastern N. Y. Chapter; F. R. Collins, Jr. and C. W. Stone, Niagara Frontier Chapter; S. F. Gilman and L. L. Schneider, Central N. Y. Chapter; S. Walzer and S. L. Gayle, Long Island Chapter; J. M. Morse and S. A. Spencer, New York Chapter; J. Curran, Western Mass. Chapter; R. E. Wilkenson and C. H. Dow, Rhode Island Chapter; C. E. Parmelee and G. A. Freeman, North Jersey Chapter; L. C. Englehart and H. J. Dyminski, Rochester Chapter; R. B. Cahoon and G. Defeo, Southern Conn. Chapter; A. S. Decker and F. J. Raible, Jr., Northern Conn. Chapter; and L. Hesselschwerdt, Jr., Boston Chapter. Also shown are J. Everetts, Jr., fourth from left, second row, ASHRAE Second Vice President; A. E. Stacey, Jr., fifth from left, second row, ASHRAE Past President; R. C. Cross, third from left, top row, Executive Secretary, ASHRAE; and F. W. Hofmann, extreme right, first row, Assistant Secretary.

Seated during the Region IV luncheon at Atlanta are, from left to right, J. H. Cansdale and F. W. Hofmann, ASHRAE Assistant Secretaries; Ernest Rogers, columnist and guest speaker; J. H. Fox, ASHRAE delegate-at-large; J. Everetts, Jr., ASHRAE Second Vice President; and Dr. J. G. Woodroof, Regional Director. Behind them are members of the Atlanta Chapter Arrangements Committee: J. Kelly, J. Latimer, R. Dean, R. M. Carryl, B. Knox, E. Gorbandt, W. P. West, President of the Atlanta Chapter, W. Garrard, J. Edgar, A. C. Gowdy, Chairman of the Committee, B. L. O'Callahan, R. Lloyd and J. R. Edmundson, Publicity Chairman.

the Architect and Engineer." Frank Turnbull of Fay, Spofford & Thorndike, consulting engineers, discussed snow melting problems and Professor Samuel C. Collins of M.I.T., an authority on low temperature refrigeration, presented a paper and exhibits on that subject. Philip A. Stoddard, vice treasurer of M.I.T., addressed the dinner meeting. His subject was "Plans and Specifications of a Building and the Owner's Viewpoint."

At the Region IV meeting on October 19th and 20th, held in Atlanta with Regional Director Dr. J. G. Woodroof presiding, delegates and guests were conducted on a tour of refrigeration, heating and air-conditioning installations at the new Commerce and First National Bank buildings. Ernest Rogers, humorist and ATLANTA JOURNAL columnist, was the speaker at the luncheon.

Beautiful autumn weather greeted the delegates and guests at the Region III meeting held in colonial Williamsburg on October 21st and 22nd. Included on the schedule was a tour of the mechanical facilities in restored Williamsburg's new information center area. Earle K. Wagner, regional director, conducted the meetings.

Indianapolis was the host city at the Region V meeting held on October 24th, with Regional Director James H. Downs at the helm. During luncheon, unusual entertainment was provided by Forest F. Sample, a magician and a member of the Central Indiana Chapter.

Under the direction of Lee K. Warrick, the Region VI meeting was held on November 2nd in Des Moines. In the evening, the delegates were guests at the regular meeting of the Iowa Chapter.

Kansas City, Mo., was the location for the Region VII meeting on November 3. Regional Director, James F. Naylor, who had attended the previous day's meeting in Des Moines, was unable to preside at the Kansas City meeting. He underwent emergency surgery on his ear, due to an injury from air pressure sustained in the plane trip from Des Moines. Vice President Everetts officiated in his place. At the Kansas City Chapter meeting in the evening, attended by delegates, the speaker was Harold L. Stout, assistant director of the Engineering Division, Midwest Research Institute. His subject was "Research Trends."

During the Des Moines meeting, Walter A. Grant, fifth from right, ASHRAE President, picks from the hat the lucky Chapter who will play host at the 1961 Region VI meeting. The winner was the Michigan Chapter. Holding the hat is Lee Warrick, Regional Director.

What ASHRAE Chapters are doing

Fall tours by Chapter members included visits to the factories of manufacturers of air conditioning equipment, sportswear and aluminum. Heat pumps were under discussion at several meetings; other topics included controls, refrigerant piping and school air conditioning.

NEW YORK . . . Second of the fall series of technical seminars was held prior to the October 25th meeting. Discussing refrigeration accessories, their design, application and selection, were W. A. Reichenbach of Sporlan Valve Company, E. Lodwig of Alco Valve Company and M. A. Ramsey of Worthington Corporation.

Use of an evaporative steam condenser, a modification to the conventional steam vacuum refrigeration cycle, has brought about significant improvements in applications of this type of system, contended Elliott Spencer of Graham Manufacturing Company, Inc., main speaker of the evening. Incorporating in his talk detailed information, he described how this new development has accomplished the following: reduced condenser water requirements to approximately the amount needed for cooling tower make-up on other refrigeration systems; reduced steam requirements to a level equivalent to that used by steam-operated centrifugal equipment and absorption systems; eliminated the need for a machine room, inasmuch as the entire plant can be located in the space normally occupied by the cooling tower alone; and made the system suitable for convential air conditioning installations in the New York City area by virtue of the preceding considerations and accompanying reduction in cost and utility requirements to levels comparable to systems now in use. Discussion of operating characteristics, operating cost and maintenance requirements was welcomed.

An announcement was made of a proposed students' tour of the Union Carbide Building, to be conducted at the beginning of December.

BALTIMORE . . . Ninety members of this Chapter traveled to York, Pa., to combine their October meeting with a tour through the plant of Borg-Warner Corporation's York Div. Chapter President William H. Kruger headed the visiting delegation and A. B. Newton, Vice President and Director of Engineering at York, and R. C. Niess, Manager of Product Sales, were hosts for the plant visit.

Following a trip through the Sound and Vibration Laboratory and manufacturing areas, the regular meeting was held, with W. E. Blazier, Jr., Manager of Acoustical Research for York, as principal speaker. He told the group of his company's work in acoustics and stressed the need for industry-wide standards of sound measurement, stating that as air conditioning is being regarded more and more as a necessity rather than a luxury, the public is becoming more demanding as to the acceptable sound level of the equipment.

CENTRAL INDIANA . . . Speaker of the evening C. A. Dubberly, Manager of Components and Advance Systems, Engineering Central Air Conditioning Systems, of General Electric's Tyler, Texas, plant, discussed "Heat Pumps" at the October 11th meeting.

NIAGARA PENINSULA . . . Temperature control systems were discussed at the October 4th meeting by M. Brodie of Honeywell Controls.

NORTH PIEDMONT . . . Electric heating was compared with coal, oil and gas heating by R. L. Boyd of Edwin L. Weigand Company, guest speaker at the October 14th meeting. Assisting him was Russel Ranson of Ranson, Wallace & Company.

ST. LOUIS . . . After touring the plant at Cupples Products Company, a St. Louis aluminum manufacturer, members attending the October 17th meeting heard A. J. Haygood of Aluminum Company of America speak on "Applications of Aluminum in Air Conditioning and Heating." Aluminum foil currently is being used as the resistance device in resistance heating; the speaker covered problems arising in this, as well as other, types of heating systems. Method of joining aluminum tubing on hydronic (hot water) systems was cited as presenting a great problem. Possible solutions are being sought by the aluminum industry, and extensive experimentation is being done on solders, resin bonding and mechanical seals.

Present and future applications of aluminum

CHAPTER MEETING DATES

	Dec.	Jan.	Feb.
Alamo	—	—	—
Arkansas	20	17	21
Atlanta	—	9	13
Austin	3	10	16
Baltimore	1	5	2
Baton Rouge	21	18	21
Boston	—	—	—
British Columbia	9	11	15
Central Arizona	5	9	6
Central Indiana	—	10	14
Central Michigan	13	10	14
Central New York	14	11	8
Central Oklahoma	12	9	13
Central Pennsylvania	14	9	8
Cincinnati	—	—	—
Cleveland	12	9	13
Columbus	19	16	20
Dallas	19	16	20
Dayton	13	10	14
El Paso	19	16	20
Evansville	6	3	7
Florida West Coast	—	—	—
Fort Worth	—	—	—
Golden Gate	—	—	—
Hampton Roads	6	3	7
Houston	23	20	17
Illinois	12	9	13
Illinois-Iowa	—	16	20
Inland Empire	12	9	13
Iowa	12	9	13
Jacksonville	—	—	—
Johnstown	13	10	14
Kansas City	5	3	6
La Ville de Quebec	13	10	14
Long Island	—	—	—
Louisville	10	9	13
Manitoba	—	26	23
Memphis	19	16	20
Michigan	19	—	20

in air conditioning units were discussed, with note made that aluminum is used extensively as the cabinet material in window-type units. Development of a zinc base solder with a melting temperature of 725 F is believed to have solved the problem of joining aluminum to copper lines in present systems.

WESTERN MICHIGAN . . . Environmental test equipment for missile and electronic component parts was discussed by Charles F. Conrad of Conrad, Inc., at the October meeting. Object of the test equipment, he stated, is to simulate conditions on earth and in space, including temperature, humidity, pressure, sand and dust, rain, vibration, acceleration, radiation, high air velocities and combinations of these factors. Some of the units must operate from −100 to 800 or 1000 F and at pressures of 1000 ft below sea level to more than 200,000 ft above. Type of cooling system used to obtain extremely low temperatures is the cascade system, which utilizes Refrigerant 22 to cool Refrigerant 13, which in turn cools the chamber. Slides illustrated the discussion.

CENTRAL ARIZONA . . . Bevin Jones of Arizona Public Service Company, a Charter Member of this Chapter, was host in a guided tour of the APS Computer Building on October 3rd. Assisting him were Walter Levi and David Rolan. Prior to the tour, Mr. Jones spoke briefly on air conditioning problems encountered in the installation and remarked that while some computers now being sold do not require air conditioning, the space in which they are housed still does.

DAYTON . . . Emphasized in the talk on "Heat Pumps", presented at the October 11th meeting by R. G. Werden of Valley Engineering Company, was the importance of a complete study of heat energy entering and leaving each part of a commercial or industrial building before selection of air conditioning equipment. Examples were given of heat pumps designed so that heating and cooling loads could be shifted to various areas, and in which industrial processes were used for either heat sources or heat sinks, with resultant low operating cost.

SOUTHERN CALIFORNIA . . . Chapter President W. L. Holladay, at the October meeting, requested assistance from members in preparation of a greeting to the newest chapter of the Society, in Milan, Italy.

"Large Air Source Heat Pumps" was discussed by Fred C. Wood and Lewis R. Charde of York Corporation. History and general application were covered by speaker Wood, who noted particularly development of use of compound compression refrigeration, making this method practical and economical for colder climates. In climates similar to that of southern California, air source heat pumps with only single-stage compression may be compared favorably with other methods of heating and cooling. Simultaneous heating and cooling and practical defrosting systems were discussed.

Speaker Charde described a 400-ton system now under construction in Long Beach for Southern California Edison Company. This installation actually has two identical heat pump systems, permitting maximum flexibility for heating and cooling loads, defrosting and variable load conditions.

Both presentations were illustrated with slides of diagrams, charts and installation photographs.

CENTRAL PENNSYLVANIA . . . Second meeting of the 1960-61 season, held October 12th, featured a panel discussion between an architect, William Lynch Murray; an engineer, Harvey Cowley of Engineering Design Service; a contractor, H. B. Dissinger of H. B. Dissinger, Inc.; and a technical editor, Frank McElroy, Managing Editor of "Actual Specifying Engineer." Moderator was William McClure of McClure Company.

Speaker McElroy indicated some of the problems of specification writing and enforcement of specifications. Following his presentation, each of the other panel members remarked on the basic problems from his individual viewpoint. An open discussion centered around the trend for major subcontractors and equipment suppliers to be specified in bids, to minimize bid-shopping. Also covered was a tendency towards elimination of the "or equal" clause, with base bids and alternates growing in usage.

PHILADELPHIA . . . Division of Chapter meetings into two sessions, designated Educational and Technical, enables members to hear two lectures in an evening, on varied topics.

Scheduled for the October 13th meeting were talks by R. E. Spence of Alco Valve Company ("Control Valves for Refrigeration Systems") and Dr. Robert Denton of the University of Pennsylvania School of Medicine ("Effect of Controlled Environment on You").

Proposed program for the November meeting features discussions on "Schoolhouse Air Conditioning" (by John C. Benson of Carrier Corporation) and

	Dec.	Jan.	Feb.
Middle Tennessee	13	10	14
Minnesota	—	9	13
Mississippi	23	23	27
Mobile	19	23	27
Montreal	—	16	20
National Capital	14	11	8
Nebraska	13	10	14
New Mexico	—	—	—
New Orleans	—	—	—
New York	27	24	28
Niagara Frontier	19	9	6
Niagara Peninsula	—	3	7
North Alabama	—	—	—
North Jersey	—	—	—
North Piedmont	—	—	—
Northeastern New York	19	16	16
Northeastern Oklahoma	—	—	—

	Dec.	Jan.	Feb.
Northern Alberta	—	—	—
Northern Connecticut	14	19	16
Northern Ohio	—	—	—
Ontario	8	2	6
Oregon	15	12	16
Ottawa Valley	—	—	—
Panama & Canal Zone	—	—	—
Philadelphia	8	—	9
Pittsburgh	19	16	20
Puget Sound	13	10	14
Rhode Island	14	11	9
Richmond	—	—	—
Rochester	7	4	1
Rocky Mountain	—	—	—
Sacramento Valley	—	—	—
St. Louis	19	16	16
San Diego	13	10	14

	Dec.	Jan.	Feb.
San Joaquin	—	—	—
Savannah	—	—	—
Shreveport	15	19	16
South Carolina	—	16	20
South Florida	13	10	14
South Piedmont	—	—	—
Southern Alberta	20	17	21
Southern California	12	10	14
Southern Connecticut	—	12	9
Toledo	5	9	—
Tucson	6	3	7
Utah	—	—	—
West Texas	—	27	24
Western Massachusetts	—	19	16
Western Michigan	12	9	6
Wichita	19	16	20
Wisconsin	—	16	20

"Pump Seals — Applications and Problems" (by John R. McKinley of A. E. D'Ambly). On November 19th a Heating Seminar will be held at the University of Pennsylvania. Six sessions, conducted by authorities in various fields, will cover basic fundamentals and applications of the science and engineering of heating.

"Gas Air Conditioners," to be discussed by Walter E. Rosengartern of Philadelphia Electric Company, and "Winter Operational Problems of Refrigeration and Air Conditioning Systems," to be covered by Charles S. Leopold, consulting engineer, are announced for the December meeting.

OREGON . . . Recent trends towards twelve-month usage of school buildings was stressed by Maurice J. Wilson of Carrier Corporation in a talk on school air conditioning presented at the October 13th meeting. He also pointed out that, in this area, for approximately one-third of the current school year temperature-humidity conditions are above the acceptable level for comfort and learning. Shown in conjunction with the talk were slides illustrating economics of air conditioning and systems applicable to schools.

SACRAMENTO VALLEY . . . As representative of this Chapter to the Inter-Society Council, a coordinating group of scientific, engineering and technical societies interested in promoting related education in local schools, R. T. Andrews reported on the September 30th meeting of the group.

Announced for the November session was a joint meeting with Golden Gate Chapter. Details were discussed.

Guest speaker at the October 5th meeting was Sander D. Sheff, Vice President in charge of engineering and research, Pacific Air Products, whose talk covered "Problems of High Velocity Systems from the Fabrication and Installation Points of View." His discussion of field problems and tests in high velocity duct installations was supplemented by illustrations of specific examples of engineering practices in this area of air conditioning.

HOUSTON . . . "Pitfalls in Building Air Conditioning Systems" was the topic of Gil Wolfson, Armstrong Cork Company, guest speaker at the October meeting. A question and answer period followed his discussion.

IOWA . . . Directing his discussion primarily toward an explanation of sound measurement in terms of sound power level, Joseph Spradling of Carnes Corporation spoke at the October 10th meeting. Instruments were utilized to demonstrate principles involved.

WISCONSIN . . . Present at the October 18th meeting were student guests and officials from the University of Wisconsin. Announcements made included the appointment of Bert Fredericksen to the Heating and Ventilating Code Committee of the State of Wisconsin and scheduled appearance at the November meeting of Burgess Jennings, who will speak on "Research Frontiers in Air Conditioning and Refrigeration."

Covered in the talk of Karel Yasco, Wisconsin State Architect and October guest speaker, was the building program of the State. Discussed were State institutions, colleges and other facilities.

NEW ORLEANS . . . Present at the October 18th meeting was Regional Director James F. Naylor, who urged members to bring to the Regional Meeting their comments on the matter of Chapter representation on local code committees, which was discussed at this session by Walter Cooke, J. I. Herbert and Joseph Maloney.

Announcement was made that Chapter members E. K. Strahan, Jr., and H. F. W. Rasmussen have been advanced to Life Membership in the Society.

L. L. Denson, Program Chairman, announced the program for November, a panel discussion, and then introduced the evening's speaker, Donald S. Galbraith of Cutler-Hammer, Inc., who discussed "Some Considerations in Application of Motor Control Centers." Covering controllers from the simplest form, a single-phase manual unit, to more complicated types, he displayed samples of various controllers, including a motor control center. Discussing application and characteristics of different types of starters, he cautioned that in many cases local power company restrictions are the governing factor in starter selection. Speaker Galbraith next covered overload relays, emphasizing the difference between thermal and magnetic types and stating that magnetic relays are used primarily for large hermetic centrifugals and other applications where motor temperature is not related to ambient temperature.

PITTSBURGH . . . At the October meeting George Smetak, Chapter Vice President, reported on a letter received concerning a special physics course offered to promising students by the Pittsburgh Board of Public Education. The letter requested guest speakers for this group from the Society. After discussion, the matter was turned over to Gene Schmitz, Chairman of the Technical Committee, for resolution.

Utilizing slides to illustrate his talk, Werner Wassmandorf, Reciprocating Products Manager, Trane Company, spoke on "Refrigerant Piping." The basic refrigeration cycle was reviewed, various components of the system were discussed and then a detailed talk was given concerning sizing and installation of refrigeration discharge, liquid and suction piping. Various accessories used in refrigerant piping systems were covered also.

ILLINOIS . . . "What type of specification produces the highest quality at the lowest cost?" was answered by a panel at the October 10th meeting. Representing the owner, Earl Walls of Monsanto Chemical Company suggested taking material and equipment bids while the system is being designed. Shop drawings can then be obtained before plans are completed and better design drawings can be made. Owners' action may involve closed specifications, which are an alternate to purchasing equipment in advance of referring the job to a contractor for bids. Specifica-

tions should be tabulated on drawings, he asserted, with the "or equal" clause eliminated. A suggested substitution was the words "or approved."

Engineer Robert Burkhardt stated that owners must establish requirements, informing the engineer as to what emphasis has to be taken on first cost, operating cost and maintenance. Basic types of specifications were cited as being open type performance, used by government groups or projects; restricted specifications, which give the contractor a choice; base bid alternate price; and closed specifications, which are more precise and eliminate time lost in approving alternate material or equipment. Interrelated work should be defined fully. Well-defined specifications and drawings should outline the project clearly and adequately.

Alternates must be all inclusive, averred Elliot Gage, representing the contractor. Bid form should be explicit, as an open specification can only be enforced by much policing and analysis. The engineer should state what alternate equipment is acceptable.

Speaking for the supplier, W. W. Quitmeier stated that closed specifications are preferable to other types. Mechanical specifications, he feels, are too frequently an after thought, and it is his contention that open specifications leave loopholes for the contractor, require much research on the part of the engineer and promote substandard quality in manufacturing of equipment, encouraging package pricing on the part of the manufacturer. Closed specifications were cited as eliminating these abuses.

COLUMBUS . . . Absorption refrigeration was discussed at the October 16th meeting by a panel moderated by William Driscoll of Carrier Corporation. Speaking were: Fred Shuler of Ohio Fuel Gas Company, "Direct-fired absorption refrigeration"; William Schoonover of Trane Company, "Steam applications of absorption refrigeration"; Lowell G. Powers of Carrier Corporation, "Hot water absorption refrigeration"; and R. A. Johnson of York Corporation, "Turbine driven combined with absorption refrigeration."

ILLINOIS-IOWA . . . Growth of radiation from pipe coils to cast iron radiators to convectors to finned tubes was sketched by Court Newton, Chief Engineer, Kritzer Radiant Coils, Inc., speaker at the October 17th meeting. A member of IBR Finned Tube Technical Committee and Joint Fan-Coil Code Committee, he told about IBR ratings and changes since their inception.

NORTHERN CONNECTICUT . . . Chapter President F. J. Raible, Jr., and 1st Vice President A. Decker reported on the Region I meeting held recently in Boston, stating that Walter Heywood, current Region I Director, would no longer be able to serve. Professor C. Hemond of the University of Hartford informed members of a conference to be held on October 27th on "Efficient Use of Engineers and Scientists."

"Of the three major types of high velocity periphery systems in use today, the air water induction type appears to be the most economical," reported Robert Bald of Carrier Corporation, guest speaker at the October 20th meeting. Costs, both initial and operating, were illustrated and analyzed for dual duct, terminal reheat and air water induction systems, as related to a typical exterior zone of a large building utilizing a high glass ratio.

SOUTH FLORIDA . . . Program for the evening of October 8th was a panel discussion of "Heat Pumps," moderated by K. Cunningham and presented by a panel composed of J. Salter of Ranco, Inc.; L. H. Boissoneault, Weatherking of Florida, Inc.; Oliver Parsons, consulting engineer; and L. L. Grant of Hill York Sales Corporation. Aspects covered included manufacturing, design and probable market.

CLEVELAND . . . "Specifications, Codes, Inspectors and Insurance Requirements" was under discussion at the first meeting of the season, held October 10th. Speaking were George Evans, mechanical engineer; James Lambert of Factory Insurance Association; and Jack Jordan, Vice President of Iron Fireman.

Describing the mechanical engineer as having the responsibility of balancing economic considerations against the technical aspect of design, speaker Evans stated that the engineer must analyze new products with this in mind.

James Lambert discussed the background of F. I. A., an organization whose insurance covers firebox type boiler-burner installations. A 1945 analysis of losses showed deficiencies in safety controls, lack of controls or misapplication, which the company followed-up with establishment of codes to meet the needs as shown by this analysis.

Jack Jordan, in his discussion of Underwriters' Laboratories, Factory Mutual and F. I. A., indicated that UL was asked by the burner industry to establish min safety standards for oil and gas burners are tested as a unit and inspections in the manufacturers' plants are maintained. F. M. operates a laboratory for checking preventive devices and has field engineers to check complete boiler-burner installations. F. I. A. utilizes UL as their test organization for component parts, but requires extensive modification of UL-approved burners.

NORTHEASTERN OKLAHOMA . . . Assuming the duties of Chapter Secretary for the remainder of the term, following the appointment of Secretary Virgil E. Carrier to Manager of the Denver office of Trane Company, will be James Kirchoff. His appointment was made effective following the October meeting.

Speaker of the evening was George C. Bergtholdt of Webster Engineering Div of Midland-Ross Corporation. He presented a talk on boiler burners and controls, covering such items as burner vibration or pulsation, flame retention and burner safeguards, including various types of burner safety controls.

MICHIGAN . . . Featured at the October meeting of this Chapter was a field trip to the Michigan Memorial Phoenix Project, University of Michigan. Members present toured the Phoenix Memorial Laboratories, Ford Nuclear Reactor, Fluids Labora-

(*Continued on page* 101)

Meetings ahead

December 1-2 – National Association of Practical Refrigerating Engineers, Annual Meeting, St. Louis, Mo.

December 12-15 – Industrial Building Exposition and Conference, New York, N. Y.

January 8-12 – Thermoelectric Symposium, jointly sponsored by the U. S. Dept. of Defense, ASHRAE and other technical societies, Dallas, Texas.

January 23-24 – Industrial Heating Equipment Association, Dearborn, Mich.

February 10-11–Air Conditioning and Refrigeration Wholesalers, Annual Convention, Chicago, Ill.

February 13-16 – American Society of Heating, Refrigerating and Air Conditioning Engineers, Semiannual Meeting, Chicago, Ill.

February 13-16 – 15th International Heating and Air-Conditioning Exposition, Chicago, Ill.

March 5-8 – National Association of Frozen Food Packers, Annual Convention and Exposition, Dallas, Texas.

March 27-30–National Association of Refrigerated Warehouses, Annual Meeting, San Francisco, Calif.

March 27-31 – Third National Symposium on Temperature. Sponsored by the American Institute of Physics, Instrument Society of America and National Bureau of Standards, Columbus, Ohio.

April 5-7 – Gas Appliance Manufacturers Association, Annual Meeting, Boca Raton, Fla.

April 20-22 – Refrigeration Research Foundation, Annual Meeting, Palm Beach, Fla.

April 23-27 – National Association of Refrigerated Warehouses, Annual Meeting, Palm Beach, Fla.

June 12-15–Institute of Boiler and Radiator Manufacturers, Annual Meeting, Absecon, N. J.

June 26-28 – American Society of Heating, Refrigerating and Air Conditioning Engineers, 68th Annual Meeting, Denver, Colo.

People

R. S. Doherty, who resigned as Vice President of A. W. Cash Valve Company to open his own manufacturers' representation firm, has been named sales representative of Modine Manufacturing Company for the New York area. President of the Better Heating-Cooling Council, he has been active in the industry since 1931, when he joined Taco Heaters as a sales engineer. In 1939 he was named Manager of the New York operations, continuing in that post until the war. He rejoined Taco in 1946, leaving in 1949 to work for National-U.S. Radiator Corporation. In 1958 he joined Cash as Vice President in charge of marketing. A director of the Oil Heat Institute of America, he is active in the Institute of Boiler and Radiator Manufacturers and Gas Appliance Manufacturers Association.

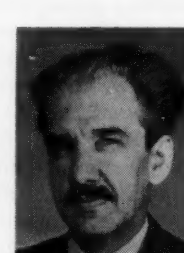
A. J. Simpson, in his new capacity as Product Manager for all division fan lines of American Radiator & Standard Sanitary Corporation, will be responsible for market planning and product development relating to fans for commercial, industrial and power plant application. A graduate of the University of Wisconsin with a degree in mechanical engineering, he joined the company's Industrial Div in 1934. Prior to accepting his new assignment, he had been Branch Manager for the Division in Baltimore for the past 14 years.

Delbert A. Hargrave has been named Vice President of Operations for Avenco, having served previously as Chief Engineer of Schaefer, Inc., since 1952. In that capacity he was responsible for product development and design, production tooling, quality control, plant layout and technical bulletins. Prior to that, he was with the Deep Freeze Div of Motor Products Corporation and is author or co-author of two patents concerning refrigeration and frozen food display cabinets.

Erich B. Utescher, formerly Supervising Chief Engineer of Kirkeby Hotels, is now Traveling Executive Engineer for Sheraton Corporation of Boston.

C. Milton Wilson has been appointed Vice President–Sales of Recold Corporation. General Sales Manager of the Air Conditioning Div since January of this year, he had served previously as General Sales Manager of Anemostat Corporation of America. One of the pioneers of high-velocity air distribution systems, he is the author of many technical articles on this subject. Active in ASHRAE, he has served on the Public Relations and Advertising Committees of the national organization and on the Executive Committee of New York Chapter.

John I. Yellott, President of John Yellott Engineering Associates, Inc., announces the establishment of a solar energy laboratory to carry out research, development and testing programs for industry, the armed services and other branches of government, and for research institutions.



Dominic D'Eustachio, appointed Director of Research, Pittsburgh Corning Corporation, has been Chief Physicist since 1956. He joined the company in 1947, having served previously as Research Director for Collman Manufacturing Corporation. A graduate of Columbia University, Dr. D'Eustachio studied for his doctorate at New York University Graduate School. He was later an instructor of physics at Brooklyn Polytechnic Institute. Active nationally in ASHRAE, he is currently a member of the Research and Technical Committee.

Frank J. Nunlist is now Vice President–Operations of Worthington Corporation. Formerly a group vice president, he will be responsible for activities of all 16 of the company's domestic heating divisions and regional engineering and service activities. He first became associated with Worthington when the company acquired the L. J. Mueller Furnace Company of Milwaukee in 1954. Subsequently he became Executive Vice President of Mueller Climatrol Div, from which post he was elected to group vice president in 1958.

Burl C. Brown has been named southeast regional sales manager by Copeland Refrigeration Corporation. Associated with air conditioning and refrigeration since 1949, he has been general manager of the Air Conditioning Dept of National-U. S. Radiator Corporation, design engineer for Coleman Company and district engineer for S. A. Long Company. He graduated from the College of Mechanical Engineering of the University of Oklahoma in 1949.

Charles A. Hathaway, as newly-appointed Vice President of Torrington Manufacturing Company, will have over-all responsibility for the Connecticut and Indiana Air Moving Divs. With the company since 1950 in various engineering capacities and in charge of all air impeller engineering from 1953-59, he has been serving as Assistant General Manager of the Connecticut Div since January of this year. A 1943 graduate of Massachusetts Institute of Technology, he worked for General Electric Company until the war. In 1946, he joined Perfex Corporation, leaving that company after one year to work in the Research Laboratories of Sharples Corporation, until he joined Torrington in 1950.

Rolland S. Stover, ASME Director-nominee (see October JOURNAL), has been reappointed to serve a two-year term as ASME Representative on Engineers' Joint Council. Owner of R. S. Stover Company and Secretary-Treasurer of Iowa Pipe & Supply Company, he is a 1933 alumnus of the University of Kansas. In the former ASHAE, he has held all offices in Iowa Chapter, being Chapter President in 1950-51 and Chairman of the national Chapter Conference Committee in 1955.

Joseph David has been appointed Regional Sales Manager for the newly-opened Chicago office of Boiler Engineering and Supply Company. Formerly a branch manager for the Cyclotherm Div of National-U. S. Radiator Corporation, he will work in coordination with distributors of the organization's packaged boilers.

H. C. Diehl, Fellow ASHRAE and Honorary Life Member of The Refrigeration Research Foundation, has been designated "Man of the Year" by the Frozen Food Association of Delaware Valley. Chairman of the Frozen Food All-Industry Coordinating Committee, Dr. Diehl is also a member of the American Association for the Advancement of Science, the Institute of Food Technologists and the American Society for Horticultural Science. As a continuing member of the International Institute of Refrigeration, he has been Vice Chairman of the U.S. National Committee for the Institute.

Ludwig Adams, Fellow ASHRAE and past-Chairman of Pittsburgh Section of the former ASRE, has joined Virginia Erection Corporation as Assistant to the President, bringing to the organization twenty years of experience in welding and corrosion protection. A director of the company since 1958, he now will be in charge of sales and technical service. Past-Chairman of the Pittsburgh Section of the American Welding Society, he wrote Chapter 7 of the Steel Structures Painting Manual.

Others are saying—

noise . . . . is defined as any random phenomenon which obscures a signal. It is this random, or unpredictable, characteristic which prevents compensation for the presence of noise, in contradistinction to systematic errors. Here considered is electrical noise, with definition given of origins and character, and procedures outlined for detection and minimization. *Electro-Technology, November 1960, p 126.*

carbon elements . . . . have been adopted as the resistance media for a new non-metallic area heating element developed by a British firm. Where high temperatures have to be applied over a small area, the conventional linear metal element offers a satisfactory means, but there are many heating requirements which are met better by evenly distributed generation of lower temperatures over large areas. Development of the new element was based on the assumption that to ensure perfectly even distribution of heat would require use of an element equal in size to the area of the surface to be heated. A metal element was unsuitable because of too low resistivity; the only practicable alternative was graphite. Most suitable base for the latter proved to be a fabric woven from glass fiber, since its extremely fine and continuous mono-filaments can be coated evenly with pure graphite in virtually colloidal form. *Journal of the Institute of Heating and Ventilating Engineers, September 1960, p 211 (British).*

winter operation . . . . of year-round chilled water air conditioning systems presents a problem in the danger of frozen water coils. Parallel flow winterizing, in which water is circulated through the coils so that the warmest water first contacts the coldest air, has proven successful in preventing frozen coils and damage resulting from burst tubes. *Air Conditioning, Heating and Ventilating, November 1960, p 91.*

Candidates for ASHRAE Membership

Following is a list of 165 candidates for membership or advancement in membership grade. Members are requested to assume their full share of responsibility in the acceptance of these candidates for membership by advising the Executive Secretary on or before December 31, 1960 of any whose eligibility for membership is questioned. Unless such objection is made these candidates will be voted by the Board of Directors.

Note: * Advancement † Reinstatement

REGION I

Connecticut

GILDA, D. A., Sr. Appl Engr., Torrington Mfg. Co., Torrington.
HEMOND, C. J., JR., Assoc. Prof. & Chairman, Dept. of Engrg. Science, University of Hartford, Hartford.
LASEWICZ, S. E., JR., Sales Engr., Johnson Service Co., West Hartford.
LINDSTROM, L. C., Sales Mgr., Torrington Manufacturing Co., Torrington.
NICHOLS, E. A., JR., Sales Engr., The Hartford Gas Co., Hartford.
RAIBLE, F. J., JR.,* Mfrs. Agt., The Trane Co., West Hartford.

Massachusetts

ARSENAULT, D. H., Asst., A. E. Borden Co., Inc., Boston.
LYNCH, W. F.,* Sales Mgr., Chicago Blower Corp., Boston.

New Jersey

BANKO, E. J., Engr., L. J. Wing Mfg. Co., Linden.
COSGRAVE, J. J.,* Sales Engr., Earle H. Figon, Elizabeth.
DRISCOLL, J. A., III, Appl. Engr., Worthington Corp., E. Orange.
KAFFERLIN, W. H., Chief Engr., L. J. Wing Mfg. Co., Linden.
MULE, J. B., Sales Engr., Chrysler Corp., Airtemp Div., Leonia.
VULTAGGIO, F. P.,† Chief Appl. Engr., L. J. Wing Mfg. Co., Linden.
WALLACE, D. A., Market Mgr., Permacel, New Brunswick.

New York

BISHOP, W. L., Engr., Aerofin Corp., Syracuse.
BOTTO, I. M., Pres., Botto Bros. Plumbing & Heating Inc., Hicksville.
DEVINE, T. M.,* Secy.-Treas., M. J. Devine & Son, Inc., Amsterdam.
EGRIN, B. N.,† N. Y. Dist. Mgr., Connor Engr. Corp., New York.
HARTZ, M. E., Constr. & Service Engr., Carrier Corp., Rochester.
JOYCE, L. J.,* Design & Sales Engr., Iroquois Gas Corp., Buffalo.
MACK, A. M., Designer, Voorhees Walker, Smith, Smith & Haines, New York.
NILSSON, R. G., Sales Mgr., A. F. Hinrichsen, Inc., New York.
STOLZ, D. L., Assoc. Engr., Haloid Xerox, Inc., Rochester.

REGION II

Canada

ALLUM, TERRENCE, Service Mgr., Canarctic Refrig. Ottawa, Ontario.
BARNES, STANLEY, Mfrs. Agt., Hamilton, Ontario.
BENONAS, BARANAUSKAS, Designer Engr., Stone & Webster, Toronto, Ontario.
BURSHTEIN, FRANK, Pres., Durall Ltd., St. Boniface, Manitoba.
CONNOLLY, R. E., Owner & Pres., Vaportite Corp., St. Genevieve, Quebec.
DONKERSLOOT, TONNY, Br. Mgr., Canadian Brown Steel Tank Co., Ltd., Winnipeg, Manitoba.
GARBUTT, J. G., Proj. Engr., Adjeleian Goodkey Weedmark & Assocs., Ltd., Ottawa, Ontario.
GOODRICH, C. M., Engr. I, Govt. of Alberta, Dept. of Public Works, Edmonton, Alberta.
GREENAWAY, JOHN, Appl. Engr., Alpha Mfg. Co., Ltd., Winnipeg, Manitoba.
HEON, N. B., Sales Engr., Johnson Controls Ltd., Quebec, Quebec.
IRWIN, J. E., Field Engr., Powers Regulator Co., Ltd., Ottawa, Ontario.
LIPES, JOSEPH, Owner, Thermodesign, Inc., Montreal, Quebec.
MARTINI, L. J., Repr., Lethbridge Sheet Metal Ltd., Lethbridge, Alberta.
POTVIN, M. A., Engr., Gilles Sarault, Cons. Engr., Quebec, Quebec.
SAGE, H. C., Repr., Honeywell Controls Ltd., Winnipeg, Manitoba.
THALL, RONALD, Sales Engr., Refrig. Components Ltd., Montreal, Quebec.
THOMPSON, G. R., Appl. Engr., Silverline Mfg. Co., Ltd., Winnipeg, Manitoba.

REGION III

District of Columbia

THOMPSON, G. E., Sales Engr., American Air Filter Co., Inc., Washington.

Maryland

EGGLESTON, J. W., JR.,* Proj. Mgr. & Sr. Estimator, Riggs Distler Co., Inc., Baltimore.
FINN, L. H., Asst. Proj. Engr., Whitman, Requardt & Assoc., Baltimore.
MILLER, R. W., Partner, Miller, Schuerholz & Gipe, Baltimore.
POKORNY, N. J., Sales Engr., The Trane Co., Bethesda.
SCHLENGER, H. A.,* Chief Mech. Designer, McNeill & Baldwin, Baltimore.

Pennsylvania

BRINJAC, J. J., Cons. Engr., Harrisburg.
FRY, C. A., Chief Mech. Engr., W. K. Hood & Assoc., Inc., York.
LOHBAUER, J. M., Service Engr., York Corp., York.
MCCLURE, W. E., Pres., McClure Co., Harrisburg.
TROWBRIDGE, W. T., Sales Engr., Ilg Electric Ventilating Co., Narberth.

Virginia

DALE, I. H.,* Dist. Mgr., The Powers Regulator Co., Arlington.
HANCKEL, A. R., Owner, Hanckel-Smith Sales Co., Norfolk.
WEBSTER, W. S., Sales Engr., Webster & Assocs., Norfolk.

REGION IV

Florida

CHIELLINI, EUGENE, Sales Engr., Chrysler Airtemp, Hialeah.
JAFFER, R. P.,* Managing Partner, Beeman, Britt, Curley & Jaffer, Inc., Tampa.
RAY, W. R., Chief Engr., Carillon Hotel, Miami Beach.
SILVERS, CHARLES,* Eng. Pres., Adams Engrg. Co., Inc., Miami.
WIRGES, CARL, JR., Vice-Pres., American National Temperature Control, Inc., Pompano Beach.

Georgia

BRAUNGART, GEORGE, Pres., Engrg. Contractors, Inc., Atlanta.

North Carolina

ANDREWS, J. V., Jr.,† Pres., J. V. Andrews Co., Charlotte.
BEECHING, S. R., Supt. of Plt. Operations, Wake County Hospital Authority, Raleigh.
WEBER, A. J., Mech. Draftsman, Walter Hook Assocs., Inc., Charlotte.

REGION V

Indiana

WARGEL, C. A.,* Reporting Engr., Mead Johnson, Evansville.

Kentucky

RABE, F. A., JR., Chief Engr., Montgomery Heating & Air Conditioning Co., Covington.

Ohio

BAKER, D. J., Repr., Mason Supply Co., Cincinnati.
BURKE, R. E.,* Chief Engr., Ellis & Watts Products, Inc., Cincinnati.
FULLER, J. L., Sr. Partner, John L. Fuller & Assocs., Cleveland.
LAAKE, D. M., Repr., Mason Supply Co., Cincinnati.
MCGOVERN, KEVIN, Sales Mgr., A. F. McGovern & Son, Columbus.
STAHL, K. V., JR., Dist. Service Supvsr., Westinghouse Electric Corp., Columbus.
THALLER, CARL, Chief Mech. Engr., Samborn-Steketee, Otis & Evans, Toledo.

REGION VI

Illinois

MUELLER, THEODORE, Research Engr., Benjamin Div., Thomas Industries, Inc., Des Plaines.

Iowa

DENSMORE, D. E., Office Mgr., Gibson-Townsend Co., Des Moines.

Wisconsin

AREVALO, F. J., Design Engr., The Hoye Heating Co., Milwaukee.
COWEN, E. J., Vice-Pres., Martin Peterson Sheet Metal, Kenosha.
DEBAUCHE, J. D., Htg. & A-C. Designer, Cashin & Assocs., Inc., Madison.
GALLAGHER, G. A., Dist. Sales Mgr., Carrier Corp., Milwaukee.

REGION VII

Alabama

KINGSTON, H. D., Vice-Pres., May Supply Co., Mobile.

Missouri

BURGER, LESTER, Contr., Kansas City.
CHALK, E. C., Sales Engr., Refrig. Equipment Co., Kansas City.
CRANDALL, M. E., Sales Engr., Johnson Service Co., Kansas City.
LAM, R. R., Sales Engr., Johnson Service Co., Kansas City.

Tennessee

HUDSON, J. C., JR., Design Engr., Allen & Hoshall, Memphis.

REGION VIII

Oklahoma

GILROY, G. W., Power Sales Engr., Oklahoma Gas & Electric Co., Oklahoma City.
TERRELL, T. D., Installation Supvsr., Minneapolis - Honeywell Regulator Co., Oklahoma City.

Texas

DIETRICH, R. W., Secy., Barber, Inc., Houston.

REGION IX

Colorado

HAWLEY, H. J.,† Sales Engr., Refrig. Distributors, Denver.
HEFLEY, D. W., Repr., McCombs Supply Co., Denver.
SHRIDE, W. O., Sales Engr., Cutler-Hammer, Inc., Denver.

Kansas

WILLIAMS, R. S., Partner, Whorton & Williams, Prairie Village.

South Dakota

BIRD, M. H., Factory Br. Mgr., The Powers Regulator Co., Sioux Falls.

Utah

HUISH, A. E., Part Owner, Vice-Pres., Sales Mgr., Armstrong Supply Co., Salt Lake City.
SQUIRES, L. G., Sales & Engrg., Armstrong Supply Co., Salt Lake City.

REGION X

Arizona

GRONDAHL, D. C., Sales Engr., Lee Refrig. & Air-Conditioning, Inc., Tucson.

California

CHAPPELL, A. R., Engr., Sheraton Corp., San Francisco.
DEVINE, K. B., Sales Engr., Johnson Service Co., Los Angeles.
ESPEY, F. C., Sales Engr., Ilg Electric Ventilating Co., San Francisco.
GEHRKE - MANNING, JOACHIM, Job Engr., Bechtel Corp., Vernon.
GRUSZYNSKI, D. W., Sales Engr., Johnson Service Co., Los Angeles.
GUINEE, J. E., JR., Sales Engr., American-Standard, Ind. Div., San Francisco.
HERRLEIN, F. H., Jr. Repr., Southern Counties Gas Co. of California, Anaheim.
HUGHES, W. S., JR., Engrg. & Estimating, New England Sheet Metal, Fresno.
LEEDOM, E. C., JR., Sales Repr., Charles A. Gillet Co., Redwood City.
MILLER, J. A., Br. Mgr., G. J. Yamas Co., Inc., Fresno.
NEWMAN, C. T.,* Owner, Air Conditioning Survey, Los Angeles.
RUDNICK, DALMON, Owner, Emergency Refrig., Sacramento.
SCALZO, R. J., Sales Engr., English & Laurer, Inc., Los Angeles.
SEAGER, J. F., Repr., Holmes Heating & Ventilating, Van Nuys.
SHAW, J. O., Sales Engr., The Powers Regulator Co., San Diego.
STRATHMEYER, C. R., Owner, Charles R. Strathmeyer, Designer-Builder, Carmel Valley.
STUBBLEFIELD, BERT, Designer, Buonaccorsi & Murray, San Francisco.

Washington

BOILEAU, R. C., Design Engr., Harnon, Pray & Detrich, Seattle.
LEVANDER, P. K., Secy.-Treas., Jan-Pacific Co., Seattle.
MUNGER, J. J., Special Service Repr., Washington Natural Gas Co., Tacoma.
NIEBERL, ANTON, Design & Installation, H. E. Bovay Jr. Cons. Engr., Richland.

U. S. Possessions

NELSON, A. E., JR., Service & Installation Mgr., Minneapolis - Honeywell Regulator Co., Honolulu.
WATERWORTH, D. G.,* Appl. Engr., Minneapolis - Honeywell Regulator Co., Honolulu.

FOREIGN

Australia

KIPPE, G. C., Mgr. & Co. Director, Kippe Industries Pty. Ltd., Melbourne, Victoria.
WINTER, F. W., Sr. Partner, W. G. Cropper & T. Andrew, No. Sydney, N. S. W.

England

ROBINSON, D. J., A-C. Engr., Kennedy & Donkin, London.
SMITH, THOMAS, Assoc. Partner, Steenson, Varming & Mulcahy, London.

France

MUREZ, PIERRE, Chief Engr., Societe Commercial de l'Quert, Paris.

Israel

BEN-EZER, DOV, Director, Part-Owner, & Chief Engr., Alboa Engrg. Co. Ltd., Tel Aviv.

Sierra Leone

HESS, KARL, Freetown Cold Storage Co., Ltd., Freetown

South Africa

MURRAY, D. J., Testing & Servicing Engr., Airco Engrg. Ltd., Duban, Natal.

Switzerland

DONATSCH, HANS, Pres., Kuhlanlagen Universal AG, Bern-Zollikofen.

Students

BOUZMAND, ALI, Calif. State Polytechnic College, San Luis Obispo, Calif.
CHAPMAN, J. E., Calif. State Polytechnic College, San Luis Obispo, Calif.
DORSTEWITZ, W. S., Mich. College of Mining & Technology, Houghton, Mich.
FOSTER, V. E., Calif. State Polytechnic College, San Luis Obispo, Calif.
GENTRY, J. E., Calif. State Polytechnic College, San Luis Obispo, Calif.
GILBERT, R. L., Calif. State Polytechnic College, San Luis Obispo, Calif.
GILES, R. E., Calif. State Polytechnic College, San Luis Obispo, Calif.
GOODALL, W. R., Mich. College of Mining & Technology, Houghton, Mich.
HANSEN, J. F., Ore. State College, Corvallis, Ore.
HAVERTY, T. G., Calif. State Polytechnic College, San Luis Obispo, Calif.
JAIN, N. L., Mich. State University, East Lansing, Mich.
KEYSER, J. C., Ore. State College, Corvallis, Ore.
KLOUDA, J. F., Mich. College of Mining & Technology, Houghton, Mich.
KOTHANDARAMAN, C. P., Mich. State University, East Lansing, Mich.
LASSEGARD, J. P., Calif. State Polytechnic College, San Luis Obispo, Calif.
LOERA, L. F., Calif. State Polytechnic College, San Luis Obispo, Calif.

LUX, J. O., Calif. State Polytechnic College, San Luis Obispo, Calif.
MATSUHIRO, D. S., Ore. State College, Corvallis, Ore.
MOORE, R. H., Ore. State College, Corvallis, Ore.
MOTAMEDY, FOROUD, Calif, State Polytechnic College, San Luis Obispo, Calif.
MULCHANDANI, P. H., Purdue University, Lafayette, Ind.
OCHS, R. D., Calif. State Polytechnic College, San Luis Obispo, Calif.
OKAHARA, D. K., Ore. State College, Corvallis, Ore.
RAWLINSON, G. R., Purdue University, Lafayette, Ind.
PACKARD, R. E., Calif. State Polytechnic College, San Luis Obispo, Calif.
PARKER, R. L., Calif. State Polytechnic College, San Luis Obispo, Calif.
POON, JASON, University of Wis., Madison, Wis.
SANDBERG, G. K., Ore. State College, Corvallis, Ore.
STAIHER, NICK, Ore. State College, Corvallis, Ore.
SWEANY, R. S., Purdue University, Lafayette, Ind.
TALIWALA, V. R., Wayne State University, Detroit, Mich.
VARNER, M. O., Calif. State Polytechnic College, San Luis Obispo, Calif.
WALKER, L. B., Calif. State Polytechnic College, San Luis Obispo, Calif.
WEI, S. Y., Calif. State Polytechnic College, San Luis Obispo, Calif.
WUNDERLICH, F. J., Calif. State Polytechnic College, San Luis Obispo, Calif.
ZAMANI, K. A., Calif. State Polytechnic College, San Luis Obispo, Calif.

BULLETINS and CATALOGS

Air-Cooled Condensers. Four basic types are listed in 12-page Bulletin AC-102: horizontal and vertical air flow, centrifugal fan and residential models. All four are high capacity units and completely waterless. Specially designed coils and Turbu-Flo fins are cited as increasing heat transfer as much as 15% by creating a better air wash which lowers air film resistance. Fins are spaced wide to prevent clogging by air-borne particles. Extensive tabular data includes coil and fan information, dimensions and weights, and capacities in Btu/hr at the evaporator. Units are diagrammed.
Tempromatic Corporation, Drawer 2406, DeLand, Fla.

Electric Heating. Advantages of electric heating cited in 40-page Bulletin EHT-6011M8 include improved air circulation, humidity control, clean heat, low cost, efficient temperature control, simple addition of central air conditioning and safety. Discussed are basic types of units, installation and zoned and central applications, with a selector chart presented for the specifier's convenience.
Lennox Industries, Inc., 200 S. 12th Ave., Marshalltown, Iowa.

Air Filter Media. Flyer 1545 describes and illustrates air filter media, channel stock and recommended tools for fabricating special size filters in the field. Also presented are assembly instructions and a suggested layout table.
Research Products Corporation, 1015 E. Washington Ave., Madison 1, Wisc.

Turbine and Centrifugal Pumps. Typical applications listed in four-page Bulletin 100-B59 include condenser circulation, filter service, high temperature service, hot water circulation, condensation return, cooling towers, coolant, boiler feed service, air conditioning systems and ice water circulation. Pumps in the line are described and illustrated.
Aurora Pump Div, New York Air Brake Company, Aurora, Ill.

Heat Transfer and Process Equipment. Standard and specially-engineered equipment, including storage water and instantaneous heaters, hot water converters, brine and titanium chloride coolers, organic vapor condensers, welded steel heat exchangers and pressure vessels, is the subject of four-page Bulletin 51. Also described are fabricating services for building equipment to customer's designs.
Niagara Weldments Inc., 55 Portage Rd., Niagara Falls, N. Y.

Defrost System. Designed as a companion to the Thermobank, the Thaw System, discussed in four-page Bulletin T-480, is an automatic, hot gas defrost system. Contained are a schematic line diagram of the system, tables of performance data and descriptions of construction and operation.
Kramer Trenton Company, Trenton 5, New Jersey.

Selector Switches. Four-page Catalog 24-2 describes how multi-point thermocouple selector switches may be used for such temperature checking applications as: when temperature being sensed by a number of thermocouples must be checked frequently or switched from one instrument to another; to average several temperature readings; and to switch a measuring instrument to different measuring points.

Described in detail are a rotary switch with 6, 12 or 24-point capacity; key switches for up to 144 points; and push-button models for up to 72-point operation. Drawings and photographs illustrate the text.

Information given includes minimum space requirements for wall, bench, rack or panel mounting; construction; termination arrangements; internal wiring specifications; and cabinet designs available for difficult installation situations. Switch components are described as to materials, mechanical operation and servicing ease.
Thermo Electric Company, Inc., Saddle Brook, N. J.

Roof Ventilators. Upblast discharge on these solid plastics roof ventilators for removing corrosive fumes blows exhaust high into the air, minimizing corrosion to nearby roofs and ground areas, and reducing chances of fumes re-entering the plant. All exposed parts, including the housing and impeller, are constructed of Rigidon plastics. Ten standard sizes range from 400 to 15,000 cfm. Descriptive of the units is Flyer E-7801.
Heil Process Equipment Corporation, 12850 Elmwood Ave., Cleveland 11, Ohio.

Air Conditioning Package. Featuring an extensive selection of filters, new Kennard/Nelson air conditioning units offer a complete central station package where all components, including fans, coils, humidifiers, dampers, filters, frame and casing are designed, fabricated and tested by one manufacturer to work together. Major features include a five-angle corner post of heavy gauge steel all-welded construction, double drain pan consisting of an inner and outer pan with one-in. insulation between, opposed blade dampers and choice of throw-away, cleanable and automatic filters. Units are available in both horizontal and

(*Continued on page* 91)

Rating of liquid coolers

A. T. BOGGS, III
ASHRAE Technical Secretary

Proposed Standard – In line with Society By-laws, notice is hereby published that the following standard has been approved by the Standards Committee: 24-57R – Methods of Testing for **Rating Liquid Coolers.** Review copies are available from the Technical Secretary and comments will be accepted for a period of 60 days. The suspense date for comments is February 15, 1961.

Compressors – Two new standards for air conditioning and refrigeration compressors and condensing units have been published by ARI. These replace six older ones of ARI. Standard 516-60 titled Refrigerant 12 and Refrigerant 22 Compressors and Condensing Units – 25 hp and Larger was designed to replace older standards 5-21 Freon Compressor Units 25 hp and Larger and 5-22 Freon Condensing Units, 25 hp and Larger.

Standard 516 establishes recommended definitions, specifications for standard equipment, methods of testing and rating including standard rating conditions, and safety provisions. The standard applies to water-cooled condensing units or compressor units for Refrigerants 12 or 22 incorporating open or sealed reciprocating compressors and is also applicable for these units using Refrigerant 500.

Standard 511 was designed to replace standards 5-12 Enclosed Ammonia Compressors, Vertical Single-Acting Type, 5-13 Performance of Ammonia Compressors, Vertical Single-Acting Type, 5-14 Standard Equipment for Ammonia Condensing Units, 5-15 High-Speed Ammonia Compressors. Standard 511 establishes recommended definitions, specifications for standard equipment, methods of testing and rating including standard rating conditions, application limits, and safety provisions. The standard applies to enclosed single-acting reciprocating ammonia compressors and compressor units, both valve-in-piston and valves-in-head type. Publication of these two new standards discontinues the six standards which they replace. Each standard may be obtained from the Air Conditioning and Refrigeration Institute, 1346 Connecticut Ave., Washington 6, D. C., at a price of 50c.

U. S. Government – Two new technical advisory committees have been established by the National Bureau of Standards – one on **calibration and measurement services** and one on **engineering and related standards.** These committees include leaders in specialized fields drawn from industry. The purpose of the committees is to aid NBS in cooperating with industry in the fields of pressure measurement calibration and standard practices.

The committee on Calibration and Measurement Services is an outgrowth of the tremendous increase in measurement and calibration activities in private industry and the military services in the last two years. Because of the increase in "space-age" activities, industry laboratories greatly increased in size and numbers. These laboratories perform secondary calibration services. NBS provides master standards for calibration and aids industry in putting their own standards operations on a broader and more systematic basis. The Advisory Committee has been established to facilitate liaison between NBS and industry.

The Committee on Engineering and Related Standards will be concerned with national needs for such standards as codes, specifications, standard testing methods, and standard data on the properties of engineering materials, maintaining awareness of the efforts of private organizations in these areas, fostering cooperative programs, and recommending uses of NBS's special competence for the development and application of engineering and related standards. It is expected that these committees will keep NBS informed of the needs of the nation's scientific and technological community in areas of interest to their professions.

National Bureau of Standards has reported that on October 14, 1960, the world adopted a new **international standard of length** – a wavelength of light–replacing the meter bar which has served as the standard for over 70 years. The action was taken by the 11th General Conference on Weights and Measures which met in Paris. The new standard will replace the platinum-iridium meter bar which has been kept at Paris as an international standard for length since 1889. Duplicates of the international standard meter bar have been maintained in the standards laboratories of other countries of the world. It was necessary, however, to return these duplicates to Paris frequently for calibration with the international standard. Occasionally discrepant results were obtained in these recalibrations and there was doubt in the minds of some scientists regarding the stability of the international meter bar.

The new definition of the meter relates it to a constant of nature, the wavelength of a specified kind of light which is believed to be immutable and can be reproduced with great accuracy in any well-equipped laboratory. NBS indicates, however, that the meter bars which have served as standards of length will not be discarded or placed in museums because of the new standard. The meter bars will remain important because of the ease with which they can be used for certain types of measurement.

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GETTING RID OF ICE

(*Continued from page 54*)

A more efficient source of heat is the fuel used for the aircraft propulsion. This may be burned in special hot air heaters and the warmed air circulated to the leading edges of the wings and the empennage to cause deicing. This is the more common method of using heat for aircraft deicing.

In order to get enough heat out to the wing and tail extremities, a high temperature must be employed at the heater. "Hot Plumbing" suitable for 900 F is in some cases employed when only 32 F plus is needed to melt the ice. Due to the low specific heat of air, this high temperature is required in order to transfer sufficient heat without getting execessive air duct cross sections.

In spite of these complications, hot air deicing is presently the most generally accepted method for deicing large aircraft. Its cost and complications have confined its application to only the largest aircraft.

Approximately one-fifth of the energy in gasoline goes into power. The rest appears in the form of heat. A still more efficient deicing system would use this large source of presently mostly wasted heat. The exhaust gas heat (over 2500 Btu per hp) is commonly used for the prevention or removal of carburetor ice. In small airplanes it is also the source of heat for the cabin. In a few instances it has been used for heating air for wing and empennage deicing.

Since ice always melts at 32 F, extra high temperatures are not needed if a more efficient heat transfer fluid than air is used. Boiling and condensing liquids are efficient heat transfer materials. The fluorinated hydrocarbon refrigerants are excellent for this and will not freeze at any temperature encountered by aircraft. Through the use of these liquids small ducts can be employed and the leading edges can be made of roll-bond or tubed sheet with one side flat. Then the large difference between the latent heat of vaporization of the refrigerant as compared with the low specific heat of air results in much less material needed. The large heat transfer coefficient of condensing refrigerant to metal as compared with the small coefficient of air to metal also results in a smaller heat transfer surface requirement.

A system using a refrigerant as the heat transfer medium is sealed and hence independent of ambient pressure whereas the density of hot air varies with altitude. Lower temperatures required for the same transfer of heat also result in improved safety. The above results in lighter weight and permits effective use of heat normally wasted.

As a consequence heat operated deicing or anti-icing of small single engine airplanes or larger ones is practical.

Icing of electronic devices such as aircraft antennas and radar antennas also causes problems. Mechanical breakage due to the weight of accumulated ice and interference with the electrical characteristics due to the ice are both encountered. More mechanical strength with the accompanying added weight is often used to overcome these breakage problems, but it is desirable not to have weight penalties.

In the case of radar antennas, a plastics housing with or without internal hot air heating is often used. For the larger radar antennas nothing is usually used with the result that they are inoperable in icing conditions. Since the fluorinated refrigerants are all non-conductors of electricity, here again we have an ideal fluid which can be used to transfer heat from a heat source to an area desired to be heated.

By using plastics connectors the heat source can be insulated completely electrically from the area being heated. Thus the electrical characteristics of the heat source and the area being heated are independent. The reverse of this has been used in the cooling of transformers. It is also applicable for cooling of electronic components where direct air cooling is impractical. In the miniaturization of electronic devices direct air cooling can prevent accomplishing the desired objective.

NEXT MONTH—

Previewing the ASHRAE Semiannual Meeting in Chicago, February 13-16. Program of the meeting. Abstracts of technical session papers and of those to be presented at Symposiums.

ASHRAE Financial Statements

American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.

In accordance with the authority contained in the minutes of the meeting of the Board of Directors on June 24, 1959, we have examined the Consolidated Statement of Financial Condition of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., New York, at June 30, 1960 and the consolidated results of its operations for the year then ended. Our examination was conducted in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying Consolidated Statements of Financial Conditions, of Income and Expense, and of Changes In Fund Balances of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., present fairly its financial condition at June 30, 1960 and the results of its operations for the year then ended. These statements were prepared in accordance with generally accepted accounting principles and with the directives of the Board of Directors applied on a basis consistent with that of the preceding year.

FRANK G. TUSA & CO.
Certified Public Accountants
Dated September 14, 1960

Consolidated Statement of Financial Condition— June 30, 1960

Assets

Current		
Cash on Hand and on Deposit		$169,195.19
Accounts Receivable		
Net of Allowances of $3,738.52 for Doubtful Accounts and Agency Commissions	$35,396.51	
Deposits	1,675.00	
Accrued Interest	1,690.97	38,762.48
Inventories—At Lower than Cost or Market		46,921.62
Prepaid Insurance and Dues		11,996.03
Total Current Assets		$266,875.32
Investments in Securities—At Cost		
Market Value ($416,994.06)		380,566.44
Property and Equipment		
Net of Allowance of $24,492.14 for Depreciation		129,437.33
Deferred Publication Cost		11,500.00
		$788,379.09

Liabilities and Fund Balance

Current Liabilities		
Accounts Payable		$106,714.81
Prepaid Dues and Admissions		
Candidates	$ 5,727.83	
Elected Members	5,637.55	11,365.38
Deferred Income		
Journal Subscriptions	273.81	
Earmarked Contributions	595.04	868.85
Reserve for Fluctuation of Canadian Exchange		49.87
Total Liabilities		$118,998.91
Consolidated Fund Balance		669,380.18
		$788,379.09

Consolidated Statement of Income and Fund Balance— June 30, 1960

Operating Income			
Membership Dues		$423,062.96	
Admission Fees		15,137.90	$ 438,200.86
Publications			
Advertising—Gross	$413,272.25		
Less Agency Commissions and Discounts	63,145.57	350,126.68	
Copy Sales		103,824.16	
Subscriptions and Other		17,301.43	471,252.27
Contractual Projects			13,624.11
General and Earmarked Contributions			45,330.77
Exposition Income			54,233.75
Emblem Sales			1,712.00
Total Operating Income			$1,024,353.76
Operating Expense			
All Salaries			454,972.04
Prime Cost of Publications		291,398.63	
Publications Commissions, Promotion, Other		100,363.75	391,762.38
Directors and Committees Travel			42,833.27
Chapter and Host Chapter Allowances and Supplies			40,648.35
Annual, Semi-Annual Meeting and Exhibits			17,961.88
Dues			9,708.00
Membership Promotion			784.07
Certificates, Emblems, Medals, Memory Books			4,710.07
Pension and Group Life Insurance			17,066.81
Payroll Taxes			9,929.36
Building Operation			8,460.96
Cooperative Research Agreements			11,231.04
Fund Raising			5,226.30
Rent and Electric			24,703.06
Printing, Stationery, Office Supplies			21,942.75
Other Administrative Expenses			83,584.55
Total Operating Expense			1,145,524.89

Financial Income and Other Deductions		
Interest Earned On Deposits	$ 2,856.63	
Dividends, Interest and Capital Gains	17,254.25	
Foreign Exchange and Sundry Income	624.95	
Capital Contributions of Supplemental Funds	3,408.72	$ 24,144.55
Less: Awards and Gratuity	1,500.00	
Excess of Pension and Group Life Insurance Premium Cost Over Contributions to Pension Fund	3,045.21	4,545.21
Excess of Financial Income Over Other Deductions		19,599.34
Consolidated Net Excess of Expense Over Income		(101,571.79)
Consolidated Fund Balance — July 1, 1959		770,951.97
Consolidated Fund Balance — June 30, 1960		$ 669,380.18

BULLETINS

(*Continued from page* 86)

vertical models in 14 basic sizes, with 24 arrangements per size, 500 to 36,000 cfm.

Containing information on the line is 60-page Bulletin AC-100.

American Air Filter Company, Inc., 215 Central Ave., Louisville 8, Ky.

Corrosion Control. Discussed in this flyer is how rapid film formation by pretreatment can improve cooling water corrosion control. Other factors affecting cooling water also are covered and application of pretreatment to systems constructed of other materials than steel is considered.

Betz Laboratories, Inc., Gillingham & Worth Sts., Philadelphia 4, Pa.

Compressors. Designed for outdoor installation, Unicon-Compressors have low operating weight and integrated design for extensive flexibility in most installations and to eliminate special structural requirements. Both horizontal and vertical models in sizes from three to 70 hp are described in four-page Advance Bulletin C-460. Winterstat is cited as preventing low receiver pressure and insuring operation under any weather condition, summer or winter, without manual adjustment.

Kramer Trenton Company, Trenton, New Jersey.

Boilers. Especially engineered for gas-fired hot water heating systems, these boilers, described in four-page Bulletin 10d/Hy, permit application of horizontal arrangement of boiler sections, assuring maximum heat transfer in minimum space with small water content. Construction is all-cast iron and units are tested at 250 psi hydrostatic pressure. Included in the bulletin are product illustrations and diagrams, discussion of construction and operation features, residential and commercial applications and tabulations of space heating, volume water heating and installation dimensions and weights.

Hydrotherm, Inc., Northvale, N. J.

Air Diffuser. For use as an integral part of duct installations, the Duct-D-fuser has shaped nozzles formed in a planned pattern, providing an extensive selection of air volume, distribution and direction. Installing as simply as a coupling, without special fittings or duct attachments, diffusers are cited as permitting full flow of the main body of air, eliminating projections, providing max compactness and operating in high, medium or low pressure systems without pressure valves or direction vanes. Descriptive of the product is four-page Bulletin DDF/20M/60.

United Sheet Metal Company, Inc., 540 S. Drexel Ave., Columbus 9, Ohio.

Steel for Low Temperature Applications. Partial contents page listing of this 44-page bulletin includes design considerations for steels in low temperature service; carbon steels, ASTM A201 and A212; T-1 constructional alloy steel; 2¼, 3½ and 9% nickel steel; 304 stainless steel; and range of application. Considered are notch toughness, metallurgical controls weldability, resistance to corrosion, chemical composition, design data, heat treatment, impact properties and stress-relieving.

United States Steel Corporation, 585 William Penn Pl., Pittsburgh 30, Pa.

Electric Heating. In addition to covering requirements of good house construction, 40-page Bulletin EHT-6011M8 presents various methods of heating by electricity and demonstrates the desirability of ducted systems. Detailed is how ducted electric heating provides for air freshness, humidity control, max cleanliness through continuous filtering, greater safety, better temperature control and addition of central air conditioning. Also pointed out is how ducted systems permit addition of such accessories as humidifiers, dehumidifiers, electrostatic air filters, activated charcoal purifiers, sterilizing lamps and ionization machines.

System design is treated extensively, including a description of various supply outlets and how they should be applied. Required air circulation volume, where heat should be applied, thermostat control and the matter of zoning are dealt with in detail.

Lennox Industries, Inc., Marshalltown, Iowa.

Spot Cooler. Available in two basic models, this thermoelectric unit offers application flexibility for a variety of small cooling jobs. Applications, product diagrams and power supply requirements are presented in four-page Bulletin E-TLMC(90.2)M.

Minnesota Mining and Manufacturing Company, 900 Bush Ave., St. Paul 6, Minn.

Precision Switches. Contained in 32-page Catalog No. 10-1 is detailed information on an expanded line of snap-acting precision switches. Comprehensive data is included for the hp-rated 2HL series; double-pole, double-throw DA series; and three new sealed series. Also shown is a wide variety of integral and auxiliary actuator styles.

Location of dimension drawings, descriptions, force and movement specifications, electrical ratings and a photograph of each switch are shown by a pictorial index. Data on bases, terminals, circuit arrangements and Nema standard definitions of precision snap-acting switch terms are also included.

Unimax Switch Div, W. L. Maxson Corporation, Ives Rd., Wallingford, Conn.

Air Conditioning Equipment. Listed in eight-page Bulletin LL-349-10 is this manufacturer's 1961 line of centrifugal water chillers, air handling equipment, central station air conditioning units, packaged liquid chillers, radial compressors, condensing units, cooling and heating units and fan coil equipment. Product illustrations, specifications and description are given.

Chrysler Airtemp Div, Chrysler Corporation, P. O. Box 1037, Dayton 1, Ohio.

Electronic Alarm Systems. In monitoring refrigeration, Ref-Con automatically compensates for normal defrosting cycles, eliminating chance of false alarms. Both audio and visual alarms are given in event of refrigeration failure or abnormal temperature change. A four-page bulletin presents information on the product.

Emco Sales Company, 803 Columbia Ave., Griffith, Ind.

Transfer Ducts. Designed to pass a maximum amount of air while blocking noise transmission through a ventilation opening between two rooms, Silentflow transfer ducts can be installed in a wall, ceiling or door. Acoustic performance is given in Flyer B-12 and airflow vs. static pressure differences between the two rooms are tabulated.

Silence, Inc., P. O. Box 21, Farmingdale, N. Y.

Heat Pumps. Packaged water-to-air heat pumps from three through thirty ton are covered in a four-page bulletin that presents descriptive and tabular information, as well as product illustrations. Cooling and heating capacities are listed.

Tempromatic Corporation, Drawer 2406, DeLand, Fla.

PARTS and PRODUCTS

HUMIDIFIER

Newly designed, the Model 70 humidifier is intended for installation in the return duct of a heating system, wired in parallel with the blower

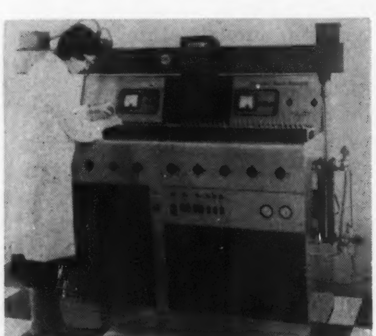
motor and in series with the fan switch. A centrifugal atomizing unit, it discharges a fine vapor into the air.

Daily capacity of the humidifier is four gal of water. Unit is constructed of corrosion resistant stainless steel and aluminum.

Skuttle Manufacturing Company, Milford, Mich.

BAKE-OUT OVEN

Installed to remove all traces of moisture from electronic components during the vacuum cycle, bake-out ovens produce temperatures from 120 to 320 C for transistor processing and to 400 C for planar-triode production. Oven temperature is controlled so variation between ports is no greater



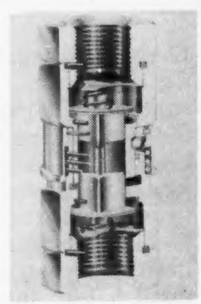
than ±5 C. Units fit over the product and are raised and lowered pneumatically. All controls for the manifold are installed in the lower portion of the front panel so they are not made inaccessible by the oven.

Designed specifically for evacuation, leak checking, gas filling and sealing of relays, transistors and similar small items, PSM-110 rapidly and thoroughly removes moisture and corrosive contaminants encountered. Time required to reduce the single-port pressure from one atmosphere to ten micron Hg. is ten sec. Ultimate pressure attainable is 8×10^{-6} mm Hg. in the high vacuum manifold.

Trent, Inc., 211 Leverington Ave., Philadelphia 27, Pa.

COUPLING SERIES

Spray which occurs when connecting or disconnecting a valved coupler-plain nipple combination is cited as having been eliminated by a new series coupling, the ES Series. Utilized is a positive metal-to-metal stop when the valve is in the closed position. This controls compression and displacement of the valve seal. An extra O-ring seal



in the coupler, in addition to the E-packer seal, prevents spray when there is internal pressure on one side of the coupling. This series, like the E Series, is designed for high or low pressure, gravity flow and vacuum systems.

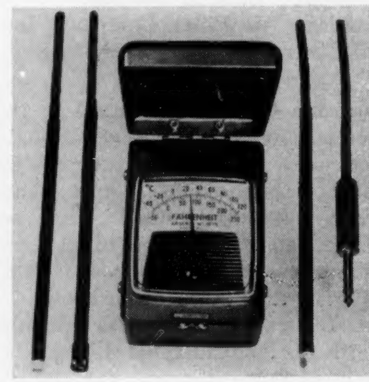
Two types of couplings are available, with both nipple and coupler valved for double shut-off or with valved coupler and plain nipple for single shutoff, and in sizes from ¼ to 6 in. with a choice of seals for handling various materials. They are made in steel, brass, aluminum, 303 and 316 stainless and are available in cadmium plate, cadmium chromate, chrome, nickel, anodized and passivated, depending on the choice of metal.

Snap-Tite, Inc., Union City, Pa.

TEMPERATURE INDICATOR

Designated Thermo-Meter, this in-instrument is standard with either a 2½ or 3-in. meter. Three interchangeable probes, with plug-in jack connectors, are available: a side-contact, 15-deg angle, and an end-contact probe are used for contact heat measurement, and a third probe responds to air temperature.

One of the many applications of this instrument is for determining super-heat setting of thermostatic expansion valves used in air conditioning and cooling systems. The meter operates electrically, but without batteries or an external source of power. Dual scales, in both F and C,



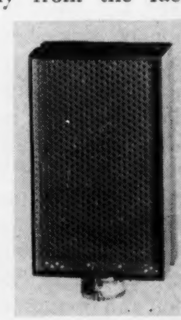
are linear for easy reading. Ranges are from -50 to 250 F and -40 to 140 C.

Airserco Manufacturing Company, 435 Melwood Ave., Pittsburgh 13, Pa.

HEAT THERMOSTATS

Designated the M7 line, these new electric heat thermostats incorporate all principal features of previous models, including snap-action switches and removable face plates, with several new modifications.

Cited is placement of the control dial at the bottom of the thermostat, removing it entirely from the face plate area. Dial calibration is in the form of a removable tape, so that the tape can be reversed if it is desired to mount the unit with the dial up. Mounting lugs have been provided on the base,



so that mounting requires only slipping the thermostat onto the base, placement of nuts on the threaded ends and tightening the nuts.

Four basic models are available: single and double-pole, load transfer and modulating. Priority control of two heating circuits is given by the load transfer model, allowing only one at a time to be energized. The modulating unit is for use with two-stage electric heat applications, in which only one stage is used for normal heating requirements.

Mears Electric Controls, Inc., Portland, Ore.


Aluminum
offers new design versatility in
AIR CONDITIONERS
through New Forms, Finishes
and Fabricating Techniques
REYNOLDS ALUMINUM
WRAP AROUND CABINET ENCLOSED ON EACH SIDE BY ALUMINUM EXTRUSIONS
PERFORATED STAMPED GRILLES
WRAP AROUND CABINET OF COLORWELD COIL. EXTERIOR GRILLE OF EXPANDED ALUMINUM.
HINGED GRILLE OF ALUMINUM SLATS
EXPANDED METAL GRILLE

How Aluminum offers air conditioner manufacturers

FLEXIBILITY and ECONOMY

IN STYLING, FABRICATING AND FINISHING

The sketches on the front side by Reynolds Styling and Design Department suggest a few of the many new ways that strong, lightweight, rustfree aluminum can contribute to air conditioner design. Because aluminum is the most versatile of all metals, it permits a wide range of styling freedom and fabricating and finishing techniques. Here are a few examples:

In fabrication, aluminum can be drawn, extruded, cast, stamped, roll formed, expanded, perforated or pierced. (The "idea" sketches show examples of expanded, extruded, stamped and perforated applications in air conditioner cabinets and grilles.) A wide choice of *attachment* methods is also available: welding, mechanical fasteners, tabs and cast pegs, bolts and rivets, metal stitching and epoxy resin adhesives are among the most common. In finishing, a wide variety of sales appealing *colors* can be easily obtained through painting or color anodizing. A variety of surface *textures* is also available.

This versatility also points the way to *manufacturing economies.* For instance, modern techniques in design, tooling and assembly permit higher rates of production with aluminum at low cost. Aluminum extrusions, with their nominal die costs, are a good example. Aluminum's light weight cuts costs of certain reinforcing or supporting parts. Lightweight aluminum also lowers handling and shipping costs. And lightweight, easier-to-handle aluminum air conditioner cabinets add important *consumer sales advantages*—especially in portable units.

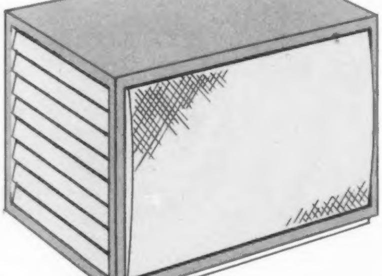
Economies in finishing are also worth investigation. One-Side-Bright Aluminum can be used to eliminate costly buffing operations. Pre-painted aluminum sheet (Reynolds Colorweld Aluminum Coil) is ideal for applications calling for a painted stock. (Note air conditioner cabinet application in "idea" sketches.) Colorweld Aluminum Coil will take most forming and fabricating operations without damage to paint surface.

Embossed or brush finished aluminum sheet, in standard or special designs, requires no additional finishing operations—permits low cost styling "change-overs". Laminates of aluminum with vinyl plastics or wood cut costs and weight in sandwich panel and other decorative or functional part construction.

Permanence of aluminum is important to you and your customers. Aluminum cannot rust, ever. This means that neither in-the-wall condensation nor year after year exterior exposure to the elements can cause aluminum cabinets to deteriorate. Unsightly rust stains on walls are eliminated.

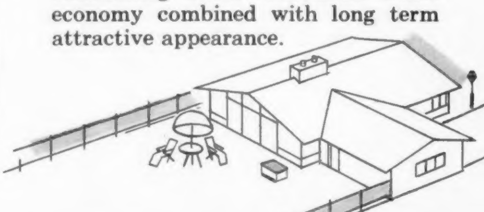
New ideas for using aluminum in air conditioners and other appliances are being developed constantly. Reynolds Styling and Design and Product Development groups are ready to assist your own stylists and engineers in putting the newest and best aluminum forms, finishes and fabricating techniques to work in your products. Reynolds fabricating facilities are also at your service to assist in actual fabrication of finished aluminum parts. For highest quality aluminum mill products or for details on these services, contact your nearest Reynolds branch office or write *Reynolds Metals Company, Box 2346-AV, Richmond 18, Virginia.*

NOTE: Before you make or buy any appliance part, have it designed and priced in aluminum. Remember—basic material costs do not determine part costs. New techniques and processes—applicable only to aluminum—can often give you a better product at a lower *final* cost.



OUTSIDE CONDENSING UNITS

Reynolds Aluminum, plain sheet or Colorweld®, is ideally suited for fabrication of wrappers for outside condensing units. Aluminum offers economy combined with long term attractive appearance.



REYNOLDS ALUMINUM

HEAT TRANSFER

(*Continued from page* 53)

Concerning the form of the final equation:

$$N_{Nu} \, [(x/a) - 17]^{0.57} = 0.15 \, N_{Re}$$

it may be mentioned that jet studies with cylindrical free jets show a potential core to exist for almost five nozzle diam downstream. Hence, complete jet decay does not start at the nozzle outlet, but may be delayed for some distance, which would explain, in part, the empirically obtained function $(x/a-17)^{-0.57}$. Under such an interpretation, the constant 17 represents the point at which jet characteristics actually begin to change for the entire jet profile. Correlations for velocity and temperature decay of the air jet passing over the curved plate have also been obtained.

ACKNOWLEDGMENT

This paper is based, in part, on material drawn from the MS thesis of Boris Kaufman (IIt, 1952). The experimental study utilized equipment made available in the IIT Heat Transfer Laboratory through a research program sponsored by the U. S. Air Force.

The cooperation of Dr. M. Spielman in certain phases of this study is hereby acknowledged. The late Dr. Max Jacob was Director of the Heat Transfer Laboratory when the experiment was carried out.

IN FEBRUARY——

This will be the Show Issue, featuring the 15th International Heating and Air Conditioning Exposition in Chicago in connection with the ASHRAE Semiannual Meeting, February 13-16. Floor Plan. List of Exhibitors.

COMMITTEES

(*Continued from page* 55)

be many members who can and will help the organization.

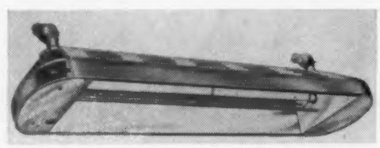
We feel local Society experience in the Chapters is a good stepping stone to National participation, but the Board of Directors, being somewhat remote from the members, has no way of sizing up committee material unless we get prospects from you in the grass roots areas and this includes yourself. You can do this by advising your Regional Director, bringing it up at Regional meetings or write to your officers.

We need your advice on this matter, please help.

PARTS and PRODUCTS

INFRARED HEATER

Developed to spot heat various areas, outdoor or indoor, this electric heater utilizes a heating element encased in a fused quartz tube. To reflect more infrared heat than is possible with aluminum reflectors, a gold plated reflector has been used. Resembling a fluorescent lighting fixture, the heater can be installed suspended from a ceiling or mounted to a wall or post. 110-volt units are ready to be wired for plug-in, 208 and 240-volt models for direct connection.



Quartz Raye Div, Pinco, Inc., 1144 S. Kestner Ave., Chicago 24, Ill.

SCREEN UNITS

Eight new models of screens for the Statronic system of dirt and dust control are made of heavy gauge metal, all-welded framing with reinforced corners. Sheet metal enclosure and access door is made of heavy gauge sheet steel with baked blue industrial finish. Screens are framed with rolled edges to prevent flutter and distortion and are constructed of heavy galvanized interwoven wire mesh. Nylon buttons on slide-out assembly provide easy removal.

As a safety feature, a factory-wired safety switch de-energizes and grounds all parts of the system when the access door is opened. The high voltage side of the screen unit is prewired to a heavily insulated screw-type external high voltage connector with an internal quick disconnect for servicing.

Furnished with all units are pre-filters of standard size, throw-away type with two-in. thick media. Horizontal and vertical models are available for either left or right-hand position of access door. Four of the units are made for a max capacity of 5,000 cfm and four for 10,000 cfm max.

CRS Industries, Inc., 1405 Locust St., Philadelphia 2, Pa.

FIRE PROTECTIVE TILES

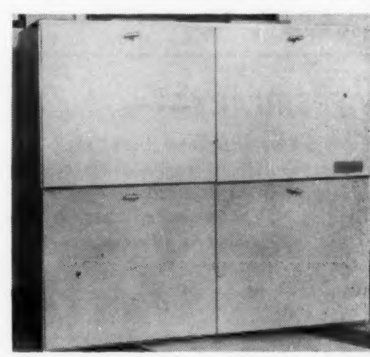
Hansoguard acoustical tiles, designed to eliminate heat transmission through ceilings to protect structural steel, are cited as providing rated fire protection to building structures. They are available in random and needlepoint perforations and are made of felted mineral fibers with special binders.

Elof Hansson, Inc., Acoustical Div, 711 Third Ave., New York 17, N. Y.

HEAT PUMP

Designated Wether-Bee, this solar-earth source heat pump uses two heat collecting and dissipating coils, one in the earth and the other exposed to the air. During the summer, heat is removed from the occupied space and rejected by the system into the ground, where it is stored until needed during colder weather. In winter, the unit extracts heat from sunlight and stores the excess in the earth reservoir, for utilization on cloudy days and after sundown.

Installation may be made in an upright, counterflow or horizontal position in a crawl-space, utility room, closet or basement. Indoor air is conditioned year-round by a single unit that humidifies and warms it in winter, dehumidifies and cools it in summer. The heat pump is manufactured also as a water source unit for either water or air distribution.



Heat Pump Systems, Inc., 232 S. River St., Aurora, Ill.

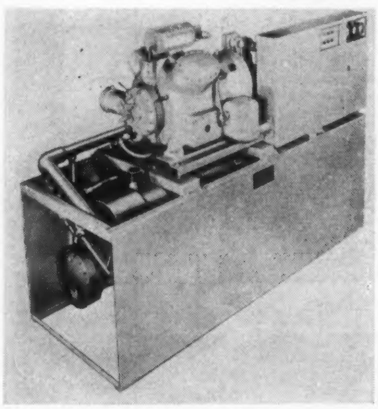
GAS-BURNING UNIT

Designed to provide heat quickly and effectively to a wide area, this gas-burning portable salamander can be used in residential, commercial, industrial or agricultural heating applications, for drying and thawing, at construction sites or for emergency heating in disaster areas. With a capacity of 50,000 Btu/hr (85,000 to 100,000 on request), the unit quickly

radiates, circulates and spreads heat over a wide area by means of a heat equalizing baffle and distributor shield. Either LP gas, butane or propane may be burned and lighting is instantaneous. In event of flame failure, gas supply shut-off is automatic. **Hauck Manufacturing Company, 124-136 Tenth St., Brooklyn 15, N. Y.**

LIQUID CHILLERS

Emphasis of this new line of hermetic packaged liquid chillers for air conditioning or industrial cooling appli-



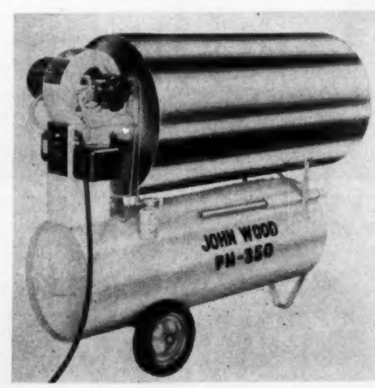
cations has been placed on versatility, compactness, ease of servicing and safety. Units are available in eleven models for net rated capacities to 67.1 ton, depending upon condenser water temperature conditions and desired leaving chilled water temperature. Standard design Versare units are available without condenser and with accessories for use on remote condenser applications. Small capacity increments from model to model give the new line extensive versatility.

Package design requires but a min of water piping and electrical connections to be made in the field. Design has been aimed at slimness sufficient to permit passage of the units through a 36-in. doorway. Hermetic compressor construction is cited as eliminating problems associated with field alignment of compressor and electric motor drive. With no shaft seal, maintenance problems and refrigerant leakage are reduced greatly.

Automatic safety switches are provided for motor overload, high motor temperature and low oil, high condenser or low cooler pressure. Included on the control panel, which is standard on all models, is an indicator system facilitating normal operating procedures. Pilot lights indicate normal unit operation and identify shut-down causes. To protect operating and maintenance personnel, the panel is divided into two separate compartments: one for the 115-volt control circuit, the other for the higher voltage power circuit. Chilled water pumps are to be interlocked electrically with the control circuit. Protection for the compressor is provided in the form of a cooler evacuation circuit and crankcase heaters. These features combine to prevent large quantities of refrigerant from accumulating in the cooler or crankcase during inoperative periods. **American Radiator & Standard Sanitary Corporation, Industrial Div, Detroit 32, Mich.**

PORTABLE HEATERS

Introduction of the Model 120 portable heater has been followed by addition of a larger model, PH 350, and a smaller unit, PH 80, to the line. Both are designed for use in buildings under construction, portable heating for plumbing, warehouse heating and



many other temporary or emergency heating applications.

No vents are needed, and units are equipped with fold-back stainless steel combustion chambers to assure complete combustion and eliminate odor, smoke and visible flame. Output of Model 350 is 350,000 Btu/hr, suiting it for peak heating demand on heavy duty jobs. Standard features include automatic control with an automatic safety cut-off. Motor is ¾ hp and operates on 110 to 120 volt ac. 80,000 Btu/hr are delivered by the smaller unit for 20 hr on one tank of fuel. **John Wood Company, Conshohocken, Penna.**

PIPING SYSTEMS

For overhead distribution of steam, hot water, process liquids and refrigeration lines, this new prefabricated piping system, designated Plasticlad, consists of pipe and insulation covered with aluminum foil, over which are two wrappings of glass fiber cloth integrated within plastics material. The entire system is factory prefabricated complete with expan-

sion loops, anchor units, elbows and "T" units ready for installation. Straight run units are prefabricated in 21-ft lengths; pipe joints can be either field welded or threaded.

Pipe and insulation for underground distribution are covered by a spiral welded metal conduit, protected against soil and stray current corrosion by a 20 to 25-mil coating of cold-cured epoxy. The epoxy coating is reinforced with glass fiber cloth, and is highly resistant to acids, alkalis and salts. Having a high dielectric strength, the material will withstand a 10,000-volt spark test. Coating is cited as being resistant to continuous temperatures of 375 F and does not crack or cold check at low temperatures. All units are factory prefabricated in sections as required. **Ric-Wil, Inc., Barberton, Ohio.**

CHIMNEY DRAFT

(Continued from page 67)

damper closed, probably due to the higher flue gas temperatures in the chimney, as well as the greater difference between maximum pressure in the chimney or fire box and potential for draft. The position of the barometric damper in this instance had little effect on the period of draft failure, being less than 1 sec at the base of the chimney and 2 or 3 sec in the fire box.

In comparing the results in Fig. 4 with those in Fig. 6, it must be noted that the burner nozzle size was 0.75 gph for the former, but was changed to 0.65 gph for the latter, with a corresponding throttling of the air supply to the burner blower. Thus, both the higher draft before start-up and the reduced capacity of the burner blower probably account for the lower positive pressures and shorter periods of draft failure shown in Fig. 6.

Sudden increase in draft at the moment the oil burner stops, in Fig. 6, is of academic interest. The rate at which the draft subsequently decreases is more important, since it relates to the draft available at the beginning of the next on-period. Fig. 7 is a record of chimney draft following extended burner operation, the beginning of which is shown in Fig. 4(b). The draft decreased rapidly for the first few minutes but was still nearly 0.03 in. of water after 50 min. Previously, the draft had decreased to 0.016 in. at the end of a 4-hr off-period. In a comparable test with an outside temperature of 6 F, similar results were obtained. The draft fell from 0.065 in. to 0.04 in. in about 15 min but was still above 0.03 in. one hr after the burner stopped. Fig. 4(c) shows that the draft was 0.02 in. of water after a 6-hr burner-off period at this outside temperature. The rate of draft decrease will depend on several variables; these results are, therefore, specific to the installation tested.

CONCLUSION

An analysis has been made of draft failure with residential heating units operating at low rates of combustion during mild, calm weather. It has been shown that under these conditions the relation between chimney draft and house pressures becomes important in de-

termining when venting failure will occur. A simple equation expressing this relation has been developed. It shows that draft failure will occur if the mean flue gas temperature in the chimney falls below a value that depends on the neutral zone level.

Under the most unfavorable conditions, excluding the effect of wind, draft failure occurs when the mean flue gas temperature in the chimney is less than the mean house temperature. Measurements have shown that this can occur with masonry chimneys located at an exterior wall and exposed to the weather on three sides, but it is unlikely when chimneys of similar construction have a substantial proportion of their length located within the heated structure.

Measurements of chimney draft and house pressures in a single-story house with an oil-fired furnace have demonstrated that draft, either with the burner on or off, is increased by lowering the neutral zone and decreased by raising it by an amount which corresponds to the change in house pressure at the furnace. The effect of furnace operation on the level of the neutral zone has also been shown. Measurements on a furnace with a high pressure oil burner have established that substantial increases in pressure occur in the fire box during start-up and that positive pressures may exist for several seconds.

Similar increases in pressure, of lesser magnitude, occur at the base of the chimney. The amount of positive pressure and the period over which draft failure occurs depends, to some extent, on the draft available prior to start-up. It appears, also, to depend on the adjustment of the burner blower. Adjustment of the barometric damper affects the positive pressures developed, since it acts as a relief opening. Draft recovery after burner start-up was quite rapid in the installation tested, even following long burner-off periods. Development of draft, following initial draft loss on start-up, was perhaps aided by the burner blower.

It would be interesting to measure the development of draft on start-up with units relying entirely on natural draft for combustion air supply, especially under conditions where no prior draft was available.

The development of furnace units with instantaneous firing rates modulated in accordance with heat requirements, in contrast with on-off firing, has often been advocated to improve heating system performance. It may be noted that draft failure, similar to that described in this paper, is a potential problem with such units, while it is largely avoided with on-off firing as commonly employed.

ACKNOWLEDGMENTS

The author wishes to thank C. Wachmann for his participation in the analysis of draft failure and R. G. Evans, laboratory technician, for his assistance with the field measurements. The advice of Dr. N. B. Hutcheon, Assistant Director of the Division of Building Research, is gratefully acknowledged. This is a contribution from the Division of Building Research, National Research Council, Canada, and is published with the approval of the Director of the Division.

CHAPTER NEWS

(*Continued from page* 81)

tory, Automotive Laboratory and wind tunnel facilities. The tour was arranged by Professor Axel Marin of the University, ASHRAE Director.

High points of the trip were the nuclear reactor, which can be seen in operation with the core under 30 ft of water; a demonstration of the burning of plasma at a temperature cited as being twice that of the sun's surface; and preliminary plans for a wind tunnel which theoretically will produce velocities of Mach 50 for fractions of a sec.

PANAMA & CANAL ZONE . . . At the October 18th meeting, Clarence May, a consulting engineer for the National Institute of Health, discussed his experiences with air conditioning in laboratory work. Emphasized was the need for extensive filtration and precise control of temperature and humidity.

Concluding the meeting was presentation of a film on duct design.

OTTAWA VALLEY . . . Combinations of unit and central systems were covered by J. Frank O'Neill of Trane Company of Canada in a talk at the October meeting, "Air Conditioning Systems." Advantages and failings of each type were discussed.

JOHNSTOWN . . . Following a brief discussion of the gas-fired air conditioning system installed at the Campus Sportswear factory in Indiana, Pa., members attending the October 11th meeting were taken on a tour of the plant. Speaker and host for the tour was Joseph Sobieski, installer of the system.

MISSISSIPPI . . . After an informal discussion of the Warm Air Training Program, led by Bowden Palmer, members approved a motion to secure more information on the subject.

H. L. Cushman of Pyle-National Multivent Div, October guest speaker, gave a slide presentation on combination lighting and air distribution systems. A film on the Echo satellite, made available by Southern Bell Telephone & Telegraph Company, was shown later in the evening.

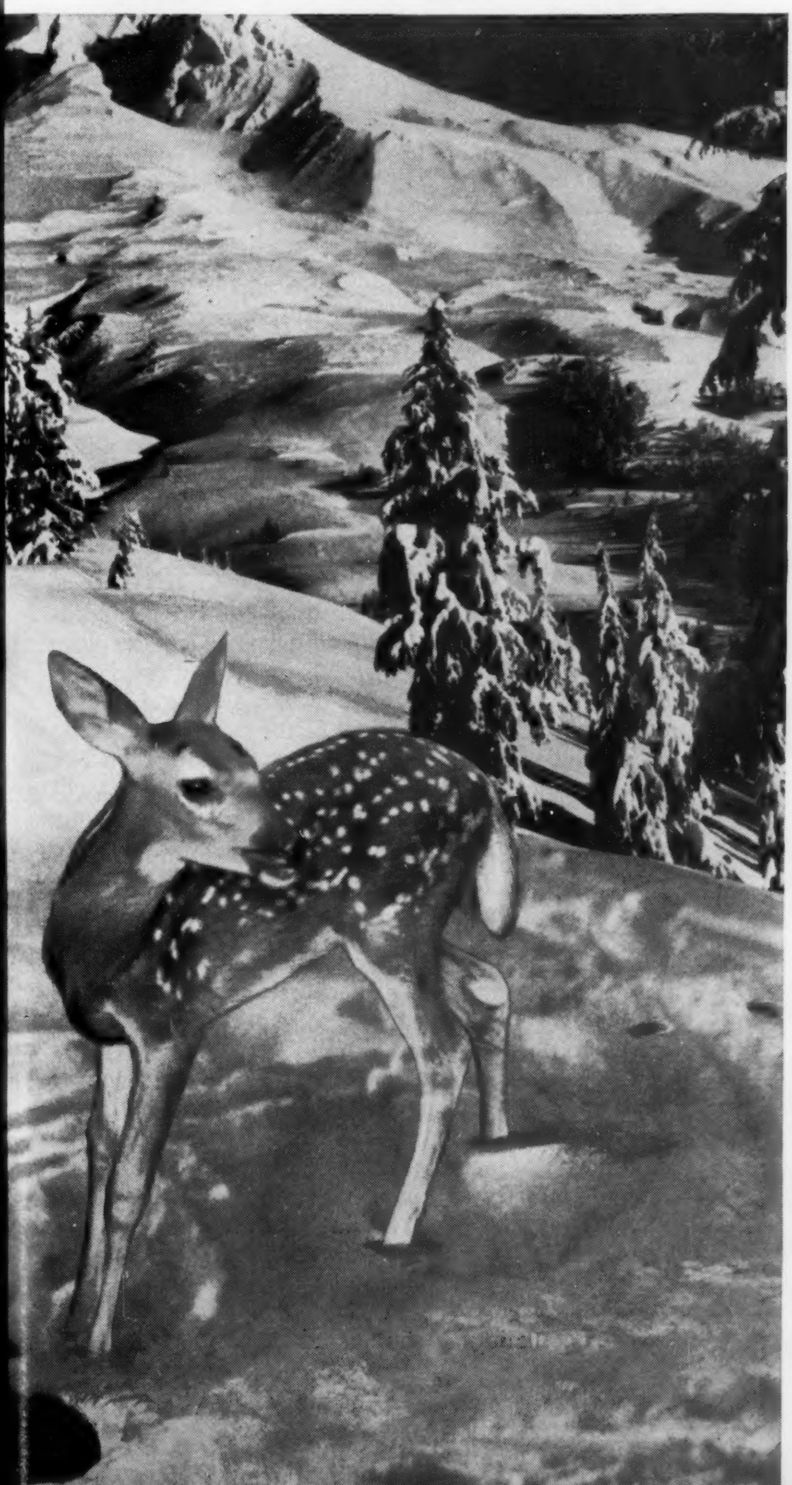
NORTH ALABAMA . . . "Operation and Function of Independent Non-Profit Research Institutes" were discussed by Dr. Francis O'Brien of Southern Research Institute. Essentially, activities of such institutes, he reported, consist of research programs paid for and sponsored by industrial organizations. SRI has done a great deal of basic research on heat pumps; of the 375 ton of air conditioning maintained in the Institute's buildings, 175 ton is provided by equipment of this type.

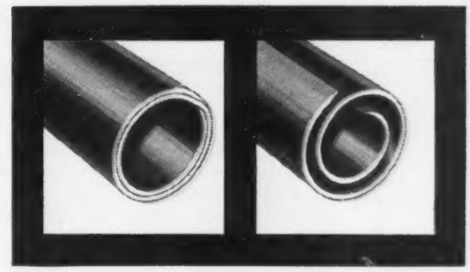
CENTRAL OKLAHOMA . . . Topic under discussion at the October 10th meeting, as presented by Neil Hill, partner in the firm of Sorey, Hill and Sorey, was design of the heat pump installation in the Oklahoma Gas & Electric Building in Oklahoma City. A discussion period followed.

Bundy can mass-fabricate practically anything

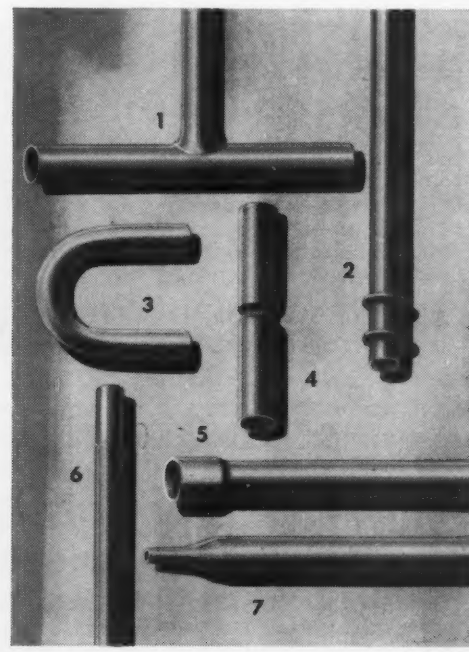
If you use tubing that requires fabricating—anything from simple bends to special forming and machining—it will pay you to talk to Bundy®. Many of these mass-fabricating operations have been developed by Bundy especially for refrigeration use, and one of them may solve a difficult tubing problem for you. Your parts will be mass-fabricated from Bundyweld, the leakproof *double-walled* steel tubing. Bundyweld has long been the safety standard of the refrigeration industry and is covered by ASTM 254; and Govt. Specification MIL-T-3520, Type III. Can Bundy help you? Phone, write, or wire: Bundy Tubing Company, Detroit 14, Michigan.

BUNDY TUBING COMPANY • DETROIT 14, MICH. • WINCHESTER, KY. • HOMETOWN, PA.
World's largest producer of refrigeration tubing. Affiliated plants in Australia, Brazil, England, France, Germany, Italy, Japan.





Bundyweld, double-walled from a single copper-plated steel strip, is metallurgically bonded through 360° of wall contact. It is lightweight and easily fabricated . . . has remarkably high bursting and fatigue strengths. Sizes available up to ⅝" O. D.



Small-diameter tubing components mass-fabricated by Bundy may be the answer to your design problem. The Bundyweld tubing shown above is: (1) saddled and soldered, (2) double-beaded, (3) bent to minimum radius, (4) grooved, (5) expanded, (6) precision-ground, (7) swaged.

BUNDYWELD® TUBING

HOUSEHOLD REFRIGERATION
a proposed ASHRAE Bulletin

To make available generally the full text of Chapter 57, as prepared originally for the 1961 ASHRAE GUIDE AND DATA BOOK but subsequently reduced considerably in length for actual publication therein, there is planned tentatively an ASHRAE 40-page Bulletin.

This will include not only the original full text for Chapter 57 but a 10-page reference to Thermoelectricity as applicable to refrigeration practice.

Authoritative, detailed and following GUIDE form, including illustrative material, this Bulletin has been authorized by the ASHRAE Publications Committee but **only to be made available if enough pre-publication orders are received to justify the project.**

Please indicate below if you are interested in this Bulletin at the prices indicated; which vary only to reflect the total quantities that may be printed.

NAME ....

ADDRESS ....

I am interested in this proposed Bulletin and would accept a charge of $1.50 or $3.00.

SIGNATURE ....

Applications

CONTROLLED ENVIRONMENT AIDS MANUFACTURE

Originally designed for the company's automated transistor production line, a complete system for precise control of purified atmosphere for manufac-

turing, assembly and testing components and parts is currently being offered by Philco Corporation's Lansdale Div. Included are dry boxes, dust shields, vacuum ovens and accessories. When in operation, the system provides five micron of oven vacuum and maintains less than ten parts per million of water vapor.

20-BUILDING DEVELOPMENT HEATED AND COOLED BY GAS

Scattered over an eleven-acre tract, the twenty buildings of Ansley Forest, a 269-unit apartment development in Atlanta, Ga., will be air conditioned and heated by a central system utilizing natural gas as the energy source. Main unit of the system is a Trane water chiller with a cooling effect of more than 300 ton. A conventional boiler of the steam type will provide heating. Both systems will utilize the same external piping, carrying either hot or cold water to the apartments in accordance with temperature requirements.

Water is basic to the entire system. This medium is first heated by gas burners, the resulting low-pressure steam being applied then to an evaporating unit. Within the unit is a solution of water (serving as the refrigerant) and lithium bromide (as absorbant). As water is evaporated from the solution, it removes heat from water contained in the refrigerating coils. From these coils, the chilled water is pumped to the apartments. Once chilled water is pumped into the individual air conditioning units, it is passed through another set of coils, cooling the surrounding air. Cooled air is circulated through the room units by a three-speed fan. The same delivery method will be used also by the heating system, coils in each apartment acting as simple radiators.

Completely self-contained, the Trane air conditioning unit is hermetically sealed to prevent air from entering the systems. Three pumps are powered by three-phase, line voltage motors and operate entirely within the water system. Magnets and strainers in the supply lines remove metallic and other foreign particles that may be suspended in the coolant.

ROOFTOP AIR CONDITIONING SPECIFIED FOR SHOPPING CENTER

To preserve the modern architectural effect of the Rayamon Shopping Center in San Juan, Puerto Rico, consulting engineers for the project specified air conditioning and refrigeration equipment that would be inconspicuous and light enough in weight for rooftop mounting without special structural requirements. Selected were four Kramer Unicon-Compressors, totaling 160 ton in capacity. San Juan's semi-tropical heat and moisture are expected to present no corrosion problem, because of the heavy gauge aluminum casing of the units and hot galvanized supports.

300,000 SQ FT OFFICE BUILDING AIR CONDITIONED FOR BOEING

As part of an expansion program, Boeing Airplane Company Transport Div constructed a 558,000 sq ft facility at Renton, Wash., for assembly of body sections of commercial jet transports. Adjacent to the manufacturing plant is a 300,000 sq ft, single-story building occupied by management, administrative, engineering, clerical and other personnel. Peripheral spaces are executive offices and conference rooms laid out on a 12-ft module. Interior spaces are large, high occupancy general office areas. A major problem in the design of an air conditioning system was selection of equipment that would allow proper zoning for each of these areas. Size of the equipment was dependent upon the building bay spacing, permissible height of penthouse equipment rooms on the roof and number and location of these penthouses required to provide an economical duct work layout.

Most of the equipment was relegated to the roof because no ground floor space was available. Selected to condition the large central areas was a built-up 30,000 cfm air handling unit with filters, heating coil with face and bypass dampers, cooling coil and a Trane SWSI down-blast discharge fan which distributes air through duct work in an attic space to diffusers in a suspended ceiling. Trane DWDI fans located in sheet metal plenums draw air from the attic spaces and either return it to the unit or exhaust it to the outside. Peripheral offices are conditioned by multi-zone units. Four penthouses are used to contain air handling equipment on the roof.

Heating medium to the system's coils is hot water at 310 F. These coils, in addition to projection unit heaters used in a boiler room and shop area and Force-Flo heaters in entryways, are designed so that a 100-F water temperature drop may be obtained. Hot water for radiation systems serving the perimeter offices is heated by the 310-F water in shell-and-tube heat exchangers.

CAPILLARY TUBES

a proposed ASHRAE Bulletin

To make available generally the full text of the Chapter on Capillary Tubes, as prepared originally for the 1961 ASHRAE GUIDE AND DATA BOOK but subsequently reduced considerably in length for actual publication therein, there is planned tentatively a special ASHRAE Bulletin.

This will include the original full text and all illustrative material.

Authoritative, detailed and following GUIDE form, this Bulletin has been authorized by the ASHRAE Publications Committee **but only to be made available if enough pre-publication orders are received to justify the project.**

Please indicate below if you are interested in this Bulletin at the prices indicated; which vary only to reflect the total quantities that may be printed.

NAME ....

ADDRESS ....

I am interested in the proposed Capillary Tube Bulletin and would accept a charge of $1.50 or $3.00.

SIGNATURE ....

CLASSIFIED ADVERTISING

RATES—Classified advertisements at this heading are inserted in 8-point type at the rate of $1.00 per line or fraction thereof, including heading and address. Eight words to the line average. Box number address counts as one line. Minimum insertion charge, 5-line basis. Maximum insertion 10 lines. Prices are net, no discounts. Box number replies promptly forwarded without charge. Available Engineers insertions up to 60 words for Full and Associate members, and Affiliates are carried free.

NO DISPLAY advertising at this heading.

CLOSING DATE: Copy must reach publisher by 10th of month preceding date of issue.

NO PROOFS shown; no free checking copies. (Single copies 50c each with order.)

Address classified advertising or requests for further information to ASHRAE JOURNAL 62 Worth St., New York 13, N. Y.

OPENINGS

SALES ENGINEER wanted. Must have experience calling on the cold storage, meat and food processing industries. Reply to: Rigidbilt, Inc., 9240 W. Belmont Ave., Franklin Park, Ill.

ENGINEERS and DESIGNERS HVAC Plumbing, Electrical. Rapidly growing Virginia Arch.-Engr. needs qualified men for new Machanical, Electrical section. Excellent future and advancement possibilities. Send full resume. P. O. Box 269, Norfolk, Va.

DESIGN ENGINEER wanted. Expanding operations by leading manufacturer of quality dairy, food and beverage machinery has created several attractive design assignments. Requisites: M.E. or E.E. degrees and experience in one of the following areas—Machine design, materials handling machinery, liquid package fillers, heat exchanger design and electro-mechanical design. Submit resume to Industrial Relations Mgr., Cherry-Burrell Corp., 2400 6th St. S.W., Cedar Rapids, Iowa.

DESIGN ENGINEER wanted. Desire a graduate engineer with experience in sheet metal cabinet work, which would lead itself to commercial reach-in refrigerators. Must be capable of handling a project through design stage to production, including layout drawings and supervision of detail drawings. Salary commensurate with experience. Midwest location. Send resume to Personnel Mgr., P. O. Box 1356, Kansas City 15, Kansas.

AIR CONDITIONING ENGINEER required in Nairobi, East Africa for sales and engineering work using American and other equipment. Considerable experience of design and installation of this type of plant essential together with genuine interest in sales. Starting salary in region of $7000 per annum is offered with generous conditions of employment and good prospects for advancement. Free passages and substantial U.K. leave. Reply giving details of age, experience and qualifications to Box 129, ASHRAE JOURNAL.

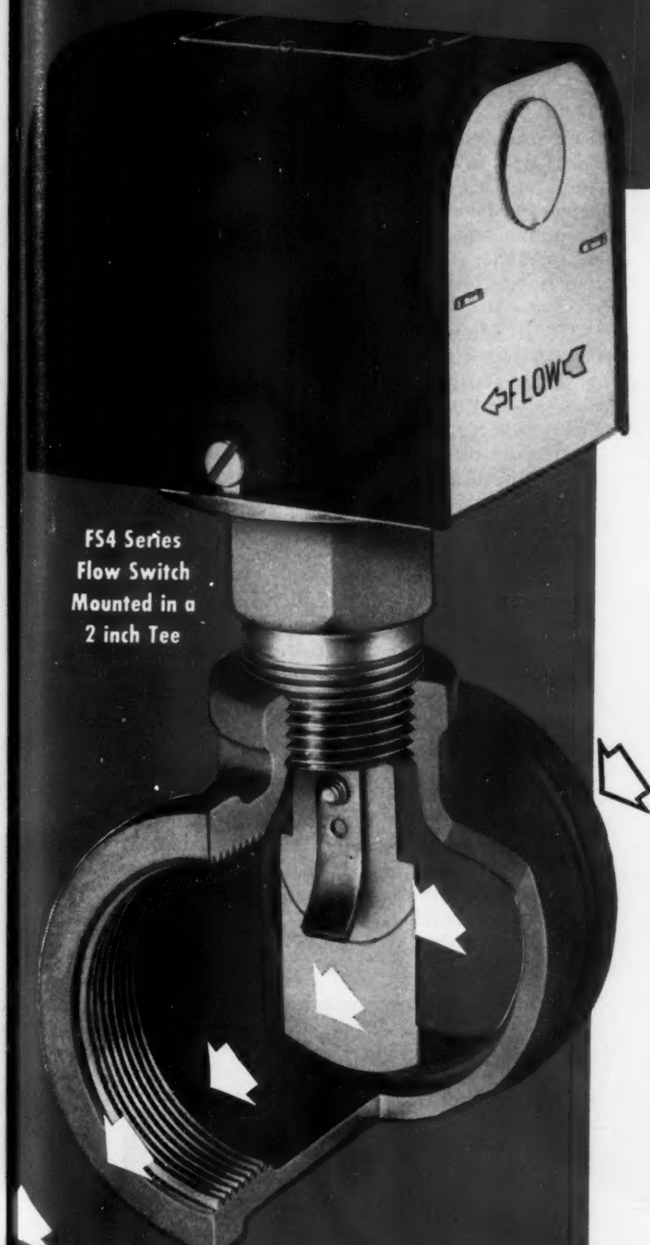
REFRIGERATION ENGINEER, JR. — Progressive, sound, commercial refrigerator firm located 30 miles south of Albany, N.Y., has an opening available for a graduate M.E. with some experience in refrigerator product design. Salary open. Top benefits. Write in full, stating experience and salary requirements. Box 130, ASHRAE JOURNAL.

ENGINEERING CONSULTANT-PARTNER — Seeking professional Engineer, with heavy experience in HVAC to become partner in long-established general consulting engineering firm, engaged primarily in Industrial and Public Building design. Firm located in desirable community well out of Metropolitan New York area. Must have minimum 15 yr experience and be skilled in developing new business. Box 136, ASHRAE JOURNAL.

AVAILABLE

MECHANICAL ENGINEER—P.E. member ASHRAE, age 41, experience as Consulting Engineer partner and chief engineer in Architects' office includes air conditioning, heating, ventilating, refrigeration and plumbing de-

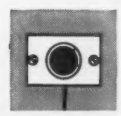
McDONNELL
Flow Switches



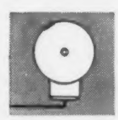
FS4 Series
Flow Switch
Mounted in a
2 inch Tee

Do you know how many jobs these switches can do?

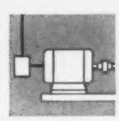
Look at the FS4 Series Flow Switch illustrated here. What you see is a compact, well-built switch that either makes or breaks a circuit (as required) when liquid flows or stops flowing. Yet in this versatile device you have both the most economical way and the most positive way of starting or stopping a signal, an alarm, a motor, a metering device—anything electrically operated. Just to highlight a few uses:—



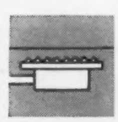
to actuate a signal light—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.



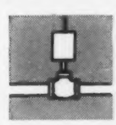
to sound an alarm—when flow stops in a process system or in any water cooled devices.



to start or stop motors—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops. These are *control* functions, and almost endless.



to start or stop automatic burners—start a booster heater when water draw occurs; stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



to actuate metering device—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

Think it over! Some of these uses may suggest some related problem the FS4 can solve for you right now. Notice the facts about its construction and service range opposite.

McDONNELL & MILLER, *Inc.*, 3500 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well
M&M SAFETY CONTROLS REG. U. S. PAT. OFF.

McDonnell quality throughout:

Compact switch with positive snap action. Removable cover and two knockouts for easy wiring. Phosphor bronze sylphon seals assembly leak-tight from line. Paddle made in segments to fit any pipe from 1" through 3". FS4 series, illustrated, is for maximum working pressure 100 psi; maximum temperature, 300° F., in types as follows:

FS4-3 Single pole, double throw switch. Opens and closes two separate circuits with flow. Closes and opens same two circuits with no flow.

FS4 Closes with flow, opens with no flow.

FS4R Opens with flow, closes with no flow.

Underwriters' Listed

● Model E-2 available for larger pipe sizes and pressures to 150 psi.

Coupon brings bulletin

It covers design, construction, electrical ratings and dimensions. Points out many typical applications.

Please send me a copy of Flow Switch Bulletin FS1.

COMPANY ______________________

ADDRESS ______________________

CITY, ZONE, STATE ______________________

BY ______________________

Mail to: McDonnell & Miller, Inc., 3500 N. Spaulding Ave., Chicago 18, Illinois

ASHRAE 1960 TRANSACTIONS

Following precedent volumes and 6 x 9 in., cloth bound, ASHRAE TRANSACTIONS covering 1960 will go to press shortly.

Included will be the full record of Society events, the Semiannual Meeting in Dallas, the Annual Meeting in Vancouver (including technical papers presented at both National Meetings and discussions upon them), listings of national officers and committees, records of Chapter personnel and other established features.

As directed by the ASHRAE Executive Committee, the 1960 TRANSACTIONS will be issued in but a limited quantity and will be priced at $3.00. Previously, this book was distributed to Society members, upon specific request, without charge. Thus, those wishing to obtain a copy of the 1960 TRANSACTIONS are requested to return the form shown below.

Name ....

Address ....

I wish to have a copy of the ASHRAE 1960 TRANSACTIONS. You may bill me $3.00.

Signature ....

sign, drafting and specifications for commercial buildings, schools, hospitals, government buildings. Desire location in Rocky Mountain area or Southwest. Box 118, ASHRAE JOURNAL.

DESIGN and MANUFACTURING ENGINEER—available. Also experienced in commercial and industrial applications. Long and intimate association with direction of refrigeration and air conditioning operations, large and small. Desires position as Chief or Executive Engineer, dependent upon size of organization. Electrical and Mechanical graduate. Can originate and develop profitable new product lines. Box 131, ASHRAE JOURNAL.

AIR CONDITIONING REFRIGERATION ENGINEER—Export sales department. 13 yr experience in all phases in leading manufacturer's export division. Includes many years abroad operating distributorship's air conditioning department providing design, estimates, sales, contracts, purchases, installations, service, etc. For all types and sizes of air conditioning and refrigeration projects. Would like a responsible position with manufacturer as field representative and/or export salesman. Married, age 36. Write Box 132, ASHRAE JOURNAL.

SALES ENGINEER available. Individualistic, enthusiastic and energetic Licensed Professional Engineer with 12 yr experience in our industry (latter 6 in direct sales). Will change for challenging opportunity in engineered products sales with progressive manufacturer having realistic marketing approach. Box 133, ASHRAE JOURNAL.

AIR CONDITIONING and REFRIGERATION ENGINEER—P. E. member ASHRAE. Past 4 yr Chief Engineer—Air Conditioning for furnace manufacturer. Previous experience in residential and transportation air conditioning, truck refrigeration, domestic refrigerators and freezers. Desires opportunity with progressive manufacturer or consulting firm. Box 134, ASHRAE JOURNAL.

HISTORIC JACKSON, now a modern gas-cooled, gas-heated city! More and more of its buildings are installing Arkla-Servel equipment for year-round gas air conditioning.

Jackson, Mississippi, beats the heat with thrifty ARKLA-SERVEL GAS cooling

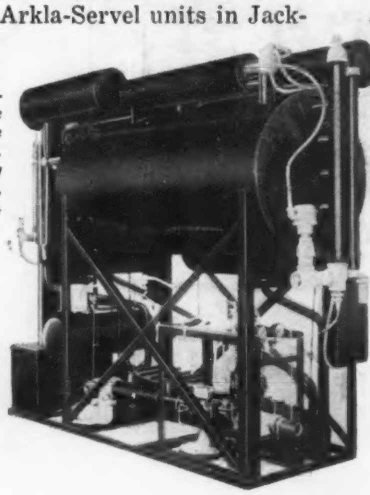
You can see dramatic evidence of the growing demand for low-cost *gas* air conditioning—when you check installations in Jackson. Here you'll find another high concentration of Arkla-Servel gas cooling... over 2400 tons in a city of 150,000 population.

Arkla-Servel gas equipment in Jackson includes scores of 25-ton absorption water chillers for larger buildings ...and hundreds of the smaller Sun Valley All-Year gas air conditioners for residential and commercial use.

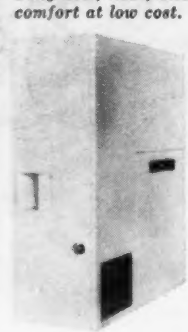
Key to the popularity of Arkla-Servel units in Jackson? Unbeatable economy and simplicity of operation for year-round air conditioning. They cool in summer, heat in winter, use one basic fuel... thrifty, safe, dependable *gas*.

Gas absorption cooling can put your customers' heating plants on a year-round paying basis. For specific details on Arkla-Servel units, call your local Gas Company. Or write to Arkla Air Conditioning Corporation, General Sales Office, 812 Main Street, Little Rock, Ark. *American Gas Association.*

ARKLA-SERVEL 25-TON GAS ABSORPTION UNITS use low-pressure steam from a gas-fired boiler as the source of energy for the chillers. They're compact, easy to install. They adjust automatically to heat loads, since steam input varies directly with capacity.



ARKLA-SERVEL SUN VALLEY 3½ AND 5-TON GAS AIR CONDITIONERS are compact central units that eliminate the need for individual fans, window air conditioners or separate cooling units. They cool, heat, clean, dehumidify and distribute air for year-round comfort at low cost.



FOR HEATING & COOLING GAS IS GOOD BUSINESS!